TECHNICAL SERVICES DIRECTORATE

Our Ref: CD/6161/19
Enquiries: [redacted]

CITY OF Armadale

7 Orchard Avenue Armadale
Western Australia 6112
Locked Bag 2 Armadale
Western Australia 6992
T: (08) 9394 5000
F: (08) 9394 5184
info@armadale.wa.gov.au
www.armadale.wa.gov.au
ABN: 798 6326 9538

30 01 2019

Department of Water and Environmental Regulation
Locked Bag 33
Cloisters Square
PERTH WA 6850

Dear Sir/Madam

CLEARING PERMIT APPLICATION – LILIAN AVE, ARMADALE

The City of Armadale (the City) received and approved the proposed subdivision and development of 3057 (Lot 65) Albany Hwy. The proposal was for the development of residential housing and a medical centre, with a number of new blocks and homes to be created requiring access to Lilian Ave (refer to site plan – Attachment 1). Within the City controlled and managed verge adjacent to the site is a number of mature Marri and Jarrah trees which have been historically pruned by Western Power to avoid damage to overhead power lines in the area, making a number of the trees potentially hazardous and unstable.

As a result the City assessed the ability to retain the trees, particularly in consideration of the future increased use of the site, and the need for a number of cross-overs or driveways to be constructed to provide access to the future homes in the this location. Initial assessments suggested the increased risk would require removal of all of the trees. However because both the City and the developer wanted to retain as many of the trees as possible, the City commissioned a professional arborist assessment to provide a recommendation on the risk of retaining each tree based on a more rigorous and technical assessment. A copy of the Arborist report is provided in Attachment 2. The developer also re-examined crossover locations and reduced the width of crossovers in some locations to minimise direct conflict with trees.

Based on the outcome of this assessment, of the 15 mature trees, only five are required to be removed based on unacceptable risk of a decline in tree health and viability long-term (and resultant human injury risk). This clearing permit application is required for the removal of the 5 Marri trees (with the City accepting long term responsibility to maintain the retained trees into perpetuity).

A more detailed description of the trees and any potential impacts associated with their removal is discussed in further detail below. A plan showing the trees proposed for removal is outlined in Attachment 1.

Overall the proposed clearing is negligible and is not considered likely to have a significant impact on environmental values.

Environmental Values

Flora and Vegetation

The proposed clearing area is located along a street verge, adjacent to a cleared residential Lot amongst a line of mature native trees. The understorey consists entirely of grassy weeds, road and path pavement (see plates 1-4 in Attachment 1).

The broader mapped vegetation complex is the Forrestfield Complex.

A total of 5 trees are proposed to be removed, comprising (also refer to Attachment 2):

- *Corymbia calophylla* (Tree # 4) – 10m height and 31cm DBH.
    - Recommend removal due to low retention value and conflict with crossover.
- *Corymbia calophylla* (Tree # 5) – 24m height and 45cm DBH
    - Recommend removal due to direct conflict with crossover
- *Corymbia calophylla* (Tree # 8) – 21m height and 70cm DBH
    - Recommend removal due to residual risk concerns and conflict with crossover.
- *Corymbia calophylla* (Tree # 9) – 6m height and 38cm DBH
    - Recommend removal due to low retention value and conflict with crossover.
- *Corymbia calophylla* (Tree # 13) – 8m height and 31cm DBH
    - Recommend removal due to residual risk concerns and conflict with crossover.

Fauna

Potential Black Cockatoo breeding trees are those that have a suitable nest hollow, or are of a suitable diameter at breast height (DBH) to develop a nest hollow. Suitable DBH is >500 mm for most Eucalypts, >300 mm for salmon gum and wandoo. One of the trees within the proposed clearing area meets the criteria for potential breeding trees (Tree # 8). This tree was examined for hollows and none were observed. Breeding viability is also reduced due to maintenance pruning undertaken by Western Power reducing the extent of foliage and therefore feeding and breeding opportunities.. Therefore it is unlikely this tree will be a suitable breeding tree for Black Cockatoos currently or long term due to the ongoing maintenance requirements.

Collectively the 5 trees provide minor foraging habitat for Black Cockatoos, with Marri (*Corymbia calophylla*) a known food source. The combined aerial canopy area of the 5 trees is approximately 350m2, and as outlined above the canopy has been significantly altered resulting in reduced limb and leaf growth otherwise present in mature Marri's of this size.

Given the lack of understorey no other fauna habitat is considered to be present on-site.

Wetlands and Watercourses

There are no Commonwealth or State listed wetlands of conservation value within the proposed clearing area, and no watercourses traverse the proposed clearing area.

The proposed clearing is minimal, and no wetlands or watercourses will be directly impacted by the proposed clearing.

Conservation Reserves

The clearing area is located at least 30m from Creyk Park (on the opposite side of Lilian Ave) which contains native vegetation, considered to be representative of the '*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain' TEC.).

Environmentally Sensitive Areas

The clearing area sits within the buffer to the TEC in Creyk reserve as outlined above, and is mapped as an Environmentally Sensitive Area (ESA), however given the altered nature of the site, the trees proposed to be cleared are not considered to be reflective of a TEC.

Conclusion

The City is of the view that the proposed clearing will not be at variance to any of the ten clearing principles, as summarised in Attachment 3.

Please find the Clearing Permit Application Form enclosed (Attachment 4).

If you have any further queries in regard to the above, please contact the City's Senior Environment Officer on [redacted]

Yours faithfully,

[redacted]

Enclosures:
Attachment 1: Site Plan and photos
Attachment 2: Arboricultural Assessment Report
[redacted]

Attachment 1: Site Plan and Photos

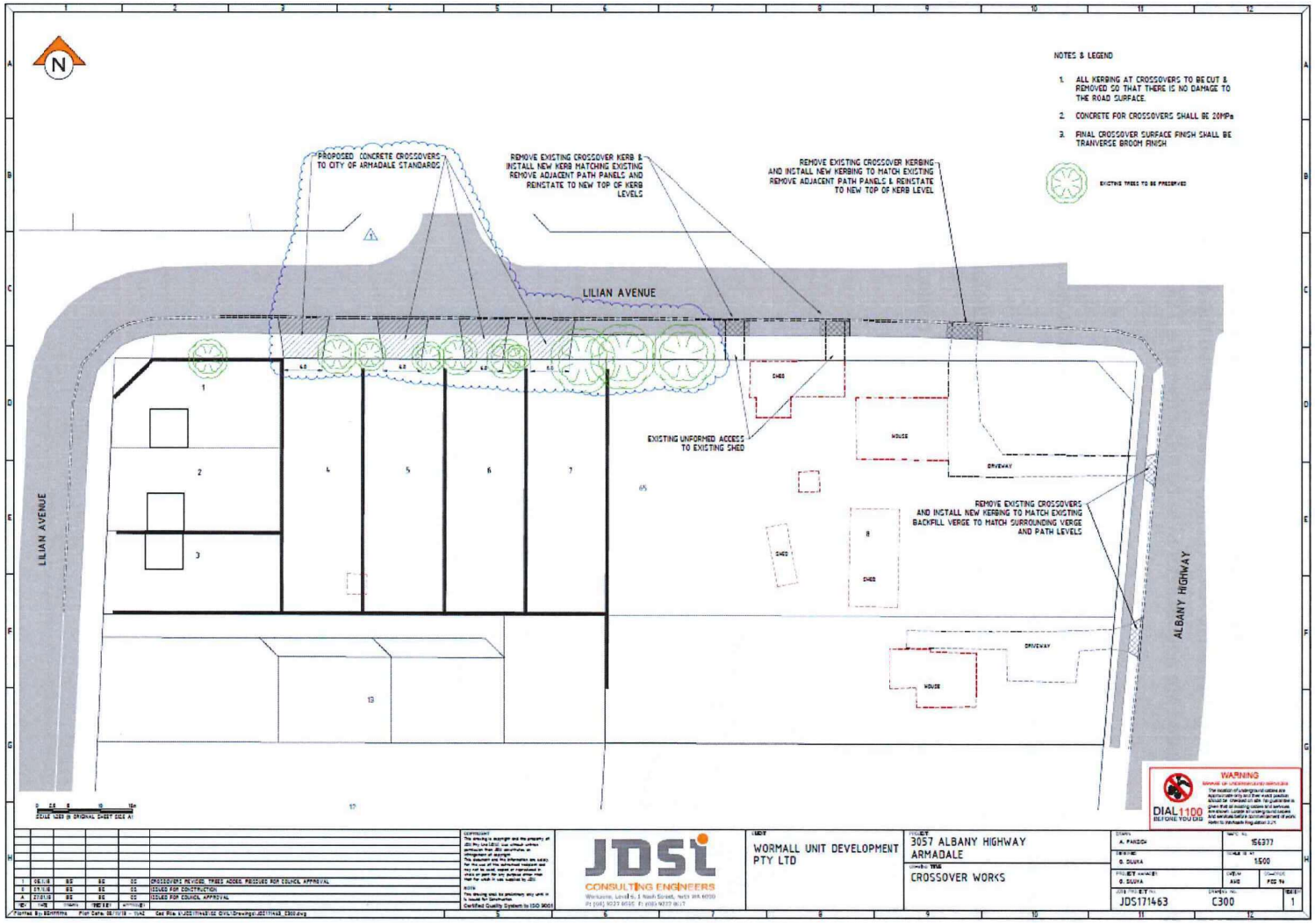


Plate 1 – Row of trees along Lilian Ave showing trees proposed for removal (red circle)

Plate 2 – Trees number 4 and 5

Plate 3 – Trees number 8 and 9

Plate 4 – Tree number 13

Attachment 2: Arboricultural Assessment Report (17/12/2018)

17th December 2018

bowden
expertise in urban tree science

[redacted]
City of Armadale
7 Orchard Avenue
ARMADALE W.A. 6112

Dear [redacted]

ARBORICULTURAL ASSESSMENT AT 3057 ALBANY HIGHWAY KELMSCOTT

Please find enclosed the results of the arboricultural survey undertaken recently for the trees at 3057 Albany Highway, Kelmscott.

Where recommendations for remedial arboricultural work have been made, it is imperative that it is undertaken as outlined in the Australian Standard 4373-2007: Pruning of Amenity Trees and/ or Australian Standard 4970-2009: Protection of Trees on Development Sites. It is also strongly advised that any remedial pruning works be undertaken by, or supervised by, a qualified arborist (AQF Level 3 in Arboriculture).

If you have any questions regarding the assessment or if I can be of service to you again in the future, please feel free to contact me.

Yours sincerely,

Brad Bowden
Principal
Bowden Tree Consultancy®

B.Sc. Sustainable Forestry
Dip. Arboriculture & Parks Management
ISA Certified Arborist – Municipal Specialist AU-0020AM & Tree Risk Assessment Qualified (TRAQ)

1.0 Introduction

1.1 Scope of Report

1.2 The purpose of this report is to summarise the results of the walkby arboricultural assessment and provide recommendations for the 15 mature trees (mixed species) located adjacent to the proposed development at 3057 Albany Highway, Kelmscott. The site visit and visual tree assessments were undertaken from ground level on the 4th and 11th December 2018 and were accurate at the time of inspection. No detailed tree assessment, soil excavation or below ground inspection was undertaken unless specified. Viewing conditions were fine. Concern has been raised by the City of Armadale regarding tree condition, the close proximity of the proposed construction activity to the existing trees, and potential for rootplate damage and subsequent decline in tree health condition. This summary report should be read in conjunction with the tree protection plan that outlines protection zones for the assessed trees adjacent to the proposed construction.

1.3 Executive Summary

1.4 The assessed trees identified within this report provide a range of benefits to the ecosystem, to human beings for environmental and health reasons, and to the climate. The assessment has identified varying tree health and structural conditions for the trees throughout the site and each tree has been allocated a retention value category of either high, medium, or low. Trees assessed as having a high retention value have a good health and structural condition, a long useful life expectancy, and should be considered for retention as part of any proposed development. Such trees for retention require incorporation at the design stage of the project and adequate tree protection measures should be utilised as outlined in the Australian Standard 4970 (2009): Protection of Trees on Development Sites.

1.5 Where minor excavation into the TPZ is required however due to the site constraints, it should be undertaken using root sensitive excavation techniques such as hand-digging or soil vacuum, to avoid damaging tree roots. It is imperative that all encroachment/ excavation be excluded entirely from the structural root zone (SRZ) of the trees to mitigate the potential for damage to the large woody roots responsible for tree stability, and to alleviate the potential for construction-related impacts in the future. Such trees for retention require incorporation at the design stage of the project and adequate tree protection measures should be utilised throughout the project as outlined in the Australian Standard 4970 (2009): Protection of Trees on Development Sites.

2.0 Site Investigation

2.1 Tree Locations

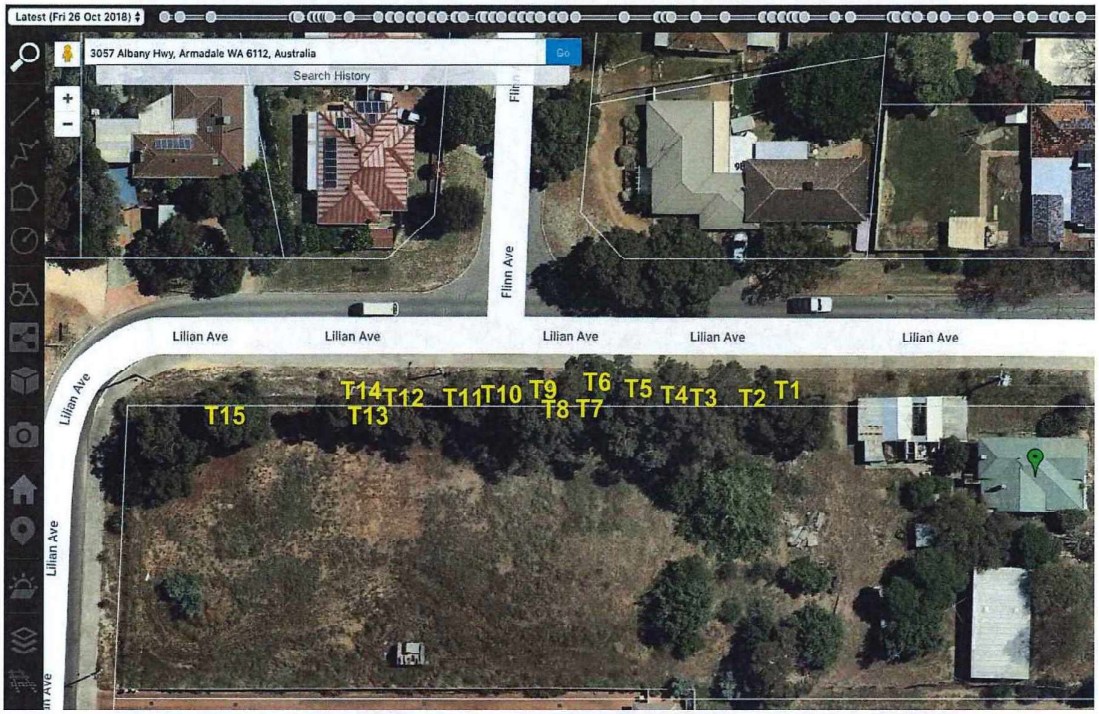


Figure 1. **Aerial photo of site with the 15 mature trees located adjacent to the proposed development at 3057 Albany Highway, Kelmscott.**

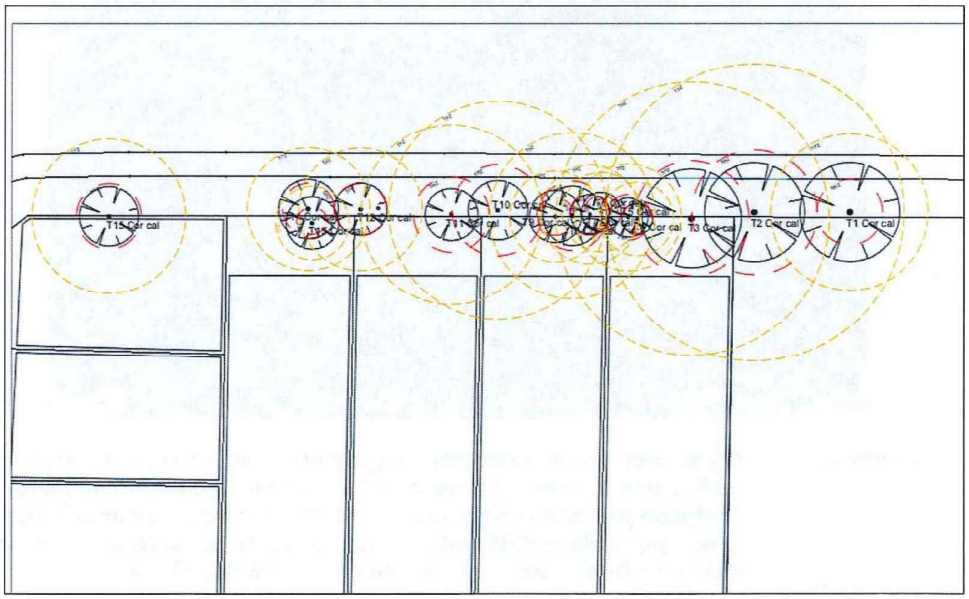


Figure 2. **Tree protection plan with the tree numbering T1-15 allocated to the 15 trees assessed adjacent to the proposed construction.**

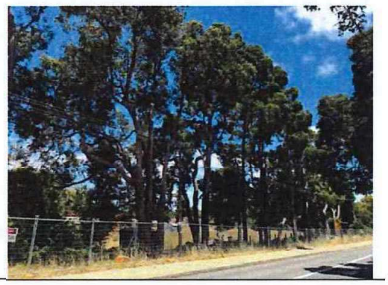
Figure 3. **Municipal verge area with existing marri and jarrah trees located adjacent to the proposed construction activity; looking towards the east.**

Figure 4. **Crossover construction was proposed within close proximity (see yellow peg) of several trees on site – to alleviate the potential for tree/ rootplate damage and to mitigate root/ crossover conflicts in the future, where possible consideration could be given to narrowing crossover width to site the crossover further away from such trees.**

Tree Number:	1
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	High
Height:	17m
DBH:	0.66m
TPZ radius:	7.9m
SRZ radius:	3.3m
Remedial Options:	Crown lifting

Tree Number:	2
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	High
Height:	23m
DBH:	1.25m
TPZ radius:	15m
SRZ radius:	6.3m
Remedial options:	Deadwooding, crown lifting

Tree Number:	3
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	High
Height:	22m
DBH:	1.15m
TPZ radius:	13.8m
SRZ radius:	5.8m
Remedial options:	Deadwooding, crown lifting



Tree Number:	4
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Low
Height:	10m
DBH:	0.31m
TPZ radius:	3.7m
SRZ radius:	1.6m
Remedial options:	Consider removal for crossover

Tree Number:	5
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	24m
DBH:	0.45m
TPZ radius:	5.4m
SRZ radius:	2.3m
Remedial options:	Consider removal for crossover

Tree Number:	6
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	21m
DBH:	0.33m
TPZ radius:	4m
SRZ radius:	1.7m
Remedial options:	No work required at present

Tree Number:	7
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	24m
DBH:	0.42m
TPZ radius:	5m
SRZ radius:	2.1m
Remedial options:	No work required at present

Tree Number:	8
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	21m
DBH:	0.7m
TPZ radius:	8.4m
SRZ radius:	3.5m
Remedial options:	Deadwooding, crown lifting

Tree Number:	9
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Low
Height:	6m
DBH:	0.38m
TPZ radius:	4.6m
SRZ radius:	1.9m
Remedial options:	Consider removal for crossover

Tree Number:	10
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	19m
DBH:	0.92m
TPZ radius:	11m
SRZ radius:	4.6m
Remedial options:	Crown lifting

Tree Number:	11
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	High
Height:	19m
DBH:	0.76m
TPZ radius:	9.1m
SRZ radius:	3.8m
Remedial options:	Crown lifting

Tree Number:	12
Botanical Name:	*Eucalyptus marginata*
Common Name:	jarrah
Retention Value:	High
Height:	13m
DBH:	0.52m
TPZ radius:	6.2m
SRZ radius:	2.6m
Remedial options:	No work required at present

Tree Number:	13
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	Medium
Height:	8m
DBH:	0.31m
TPZ radius:	3.7m
SRZ radius:	1.6m
Remedial options:	Crown lifting

Tree Number:	14
Botanical Name:	*Eucalyptus marginata*
Common Name:	jarrah
Retention Value:	High
Height:	11m
DBH:	0.52m
TPZ radius:	6.2
SRZ radius:	2.6
Remedial options:	No work required at present

Tree Number:	15
Botanical Name:	*Corymbia calophylla*
Common Name:	marri
Retention Value:	High
Height:	14m
DBH:	0.65m
TPZ radius:	7.8m
SRZ radius:	3.3m
Remedial options:	Crown lifting

3.0 Discussion and Recommendations

3.1 Discussion

3.2 Tree root plate: Root plate composition for most tree species consists of a structural root zone and an absorbing root zone, responsible respectively for the support/ anchorage of the tree and the uptake of water/ mineral nutrients in solution. Severance of large diameter woody roots within the structural root zone (the root plate area immediately adjacent to the tree can compromise tree stability and result in the loss of a significant proportion of the absorbing roots – roots that are responsible for the uptake of water and nutrients, subsequently placing considerable stress upon the tree in the short term. The severance of large diameter woody structural roots also provides an entry opportunity for infection by wood decay fungi, increasing the potential for the degradation of wood tissue at the root collar and trunk basal area which can compromise tree stability. The root development for most tree species generally occurs in the upper layers of the soil profile (0-1m depth) due to higher levels of organic matter and oxygen as required by the absorbing roots, and the construction of hard surfacing adjacent to mature trees can significantly restrict these requirements.

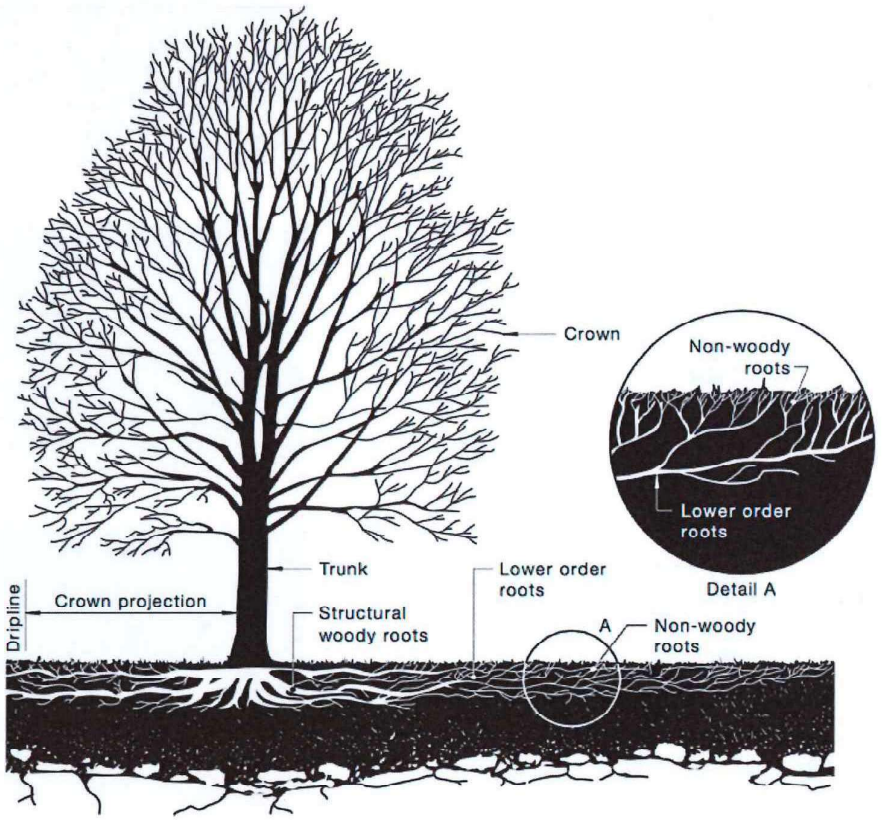


Figure 5. Typical tree structure above and below ground for cultivated urban trees. Source: AS4970-2009: Protection of Trees on Development Sites.

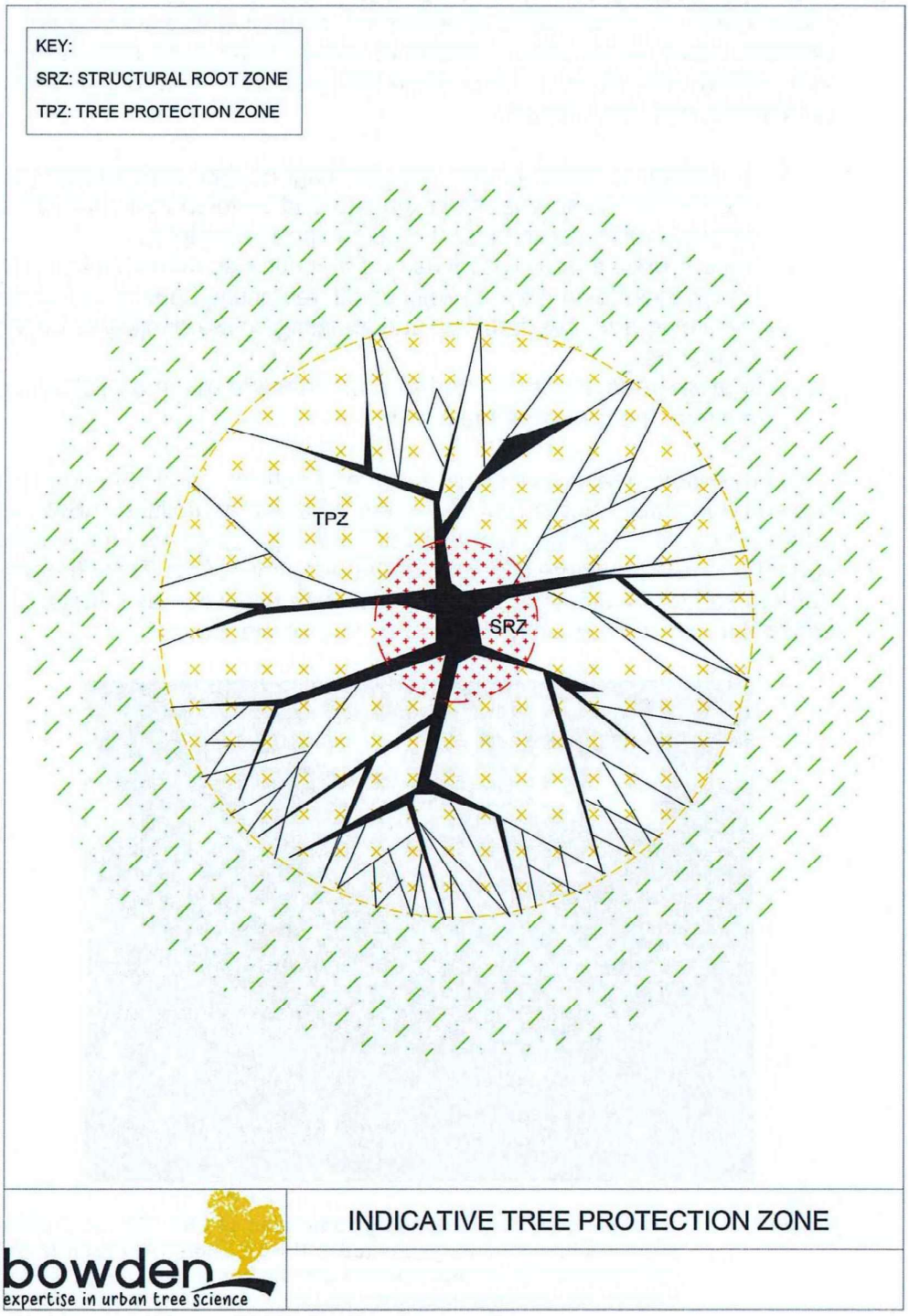


Figure 6. **Plan view of tree protection zones that delineates the area of the large woody roots that are responsible for anchorage and tree stability (SRZ), and which taper into smaller diameter non-woody absorbing roots that take up water and nutrients. Beyond the TPZ periphery (green zone), preservation of tree roots is less critical.**

3.3 Tree preservation during development: The most important goal of tree preservation on construction/ development sites or where construction activities occur within close proximity of mature trees is the long-term survival and stability of the tree/ s. To achieve this goal, three core principles must be recognised and they include:

- To preserve existing trees, the planning/ design/ construction process must respect patterns of tree growth and development, both the above ground crown section and the below ground rootplate.
- Tree preservation must focus on preventing construction injury to trees which includes mitigating soil cut/ fill, restricting continuous open trenching and root damage, and avoiding collision injury to trunks and branches.
- Mature trees require an undisturbed space to retain a healthy root system and growth of the crown.

3.4 Tree protection measures include a range of activities and structures and should be in place prior to any site works including demolition (AS4970, 2009). Protective fencing comprised of 1.8m high chain-wire mesh panels should be erected, where possible, at the periphery of the Tree Protection Zone radius (trunk diameter x 12) for each tree assessed as a material constraint and subsequently retained as part of the project.

Figure 7. Example of protective fencing comprised of 1.8m high chain-wire mesh panels, which should be erected at the TPZ periphery prior to the commencement of construction activities that have the potential to impact and damage the trunk and lower branches. Due to site constraints typical of a streetscape verge area, the use of four panels (see above) should be considered the minimum tree protection requirement.

3.5 **Roots and structures:** Structural damage to building foundations and walls can result following the removal of soil moisture. On expansive/ reactive clay soils, trees and vegetation transpire water which can result in soil desiccation and a subsequent reduction in the soil volume. This often causes subsidence of the soil surface and may result in structural failure. This type of damage is often referred to as indirect damage and occurs on expansive soil types i.e. a soil type that shrinks as it dries and is observed by large cracks on the surface of the soil.

3.6 Direct damage to structures involves lightly-loaded structures such as concrete footpaths and single course brick/ block walls. Tree root growth is opportunistic and may develop in areas with suitable levels of soil moisture, organic matter and soil nutrition. Roots of a very small diameter may pass beneath footpaths and brick walls to source water and nutrients with little initial disturbance to the structure. As root diameter increases through normal secondary thickening however, lightly-loaded structures can be displaced and damaged. The likelihood of direct damage to heavily-loaded structures i.e. a building foundation with the entire weight of the building upon it (on sandy soils), is low.

3.7 **Root sensitive design and excavation:** Where construction activities cannot occur outside the tree protection zone radius of a tree, preservation of the rootplate and subsequent tree health can be achieved by utilising a discontinuous footings and/ or minor fill soil atop the existing grade. A structural design incorporating methods such as cantilever, pier and beam (lintel), and/ or screw pile footings that spans any a structure across the root plate of the tree can be used to limit root damage and loss. The design should specify a root sensitive excavation technique such as air spading, hand digging or soil vacuum to alleviate the potential for damage to tree roots during excavation and/ or horizontal directional drilling for underground service/ conduit installation. Should minor roots (<30mm in diameter) be encountered outside the structural root zone during excavation they can be pruned cleanly with a handsaw on an angle that is perpendicular to the root edge, to limit the size of the pruning wound and to enable the fastest rate of wound occlusion. Large tree roots should be retained to avoid compromising tree stability and the design modified where possible. Any design should be approved by a structural engineer or other competent person.

3.8 **Tree benefits:** Mature urban trees confer many benefits including shade and cooler air temperatures, screening (privacy) and noise reduction, built form aesthetic amelioration, energy conservation, mitigation of the urban heat island effect, air quality improvement and oxygen production, carbon uptake/ storage and greenhouse gas reduction, minimisation of storm water run-off and improvement of water quality, fauna habitat and food source. In general, they enhance our built and natural environments with larger trees providing more benefits.

3.9 **Tree risk:** Tree failure is an infrequent occurrence and serious damage, injury or death from tree failure is rare (Lilly *et al*, 2011). Research finds that for Britain, with a population of 60 million people, the risk of any tree causing a fatality is exceedingly small (Ball & Ball-King, 2011). It is impossible to maintain trees completely free of risk and some level of risk must be accepted to experience the benefits that trees provide. The use of 'safe' or 'unsafe' when assessing trees is both imprecise and ambiguous, as a tree cannot be free from defects or potential hazards - such a state is simply unattainable. It is essential to maintain a balance between the benefits and costs of risk reduction, not only financial cost but also the loss of amenity and other tree related benefits.

Figure 8. **Where mechanical excavation is used outside the tree protection zone the selection of a toothless bucket (a) and use of a spotter can alleviate the extent of damage to the roots are they are revealed, compared with the toothed bucket (b) type which can significantly tear and damage roots.**

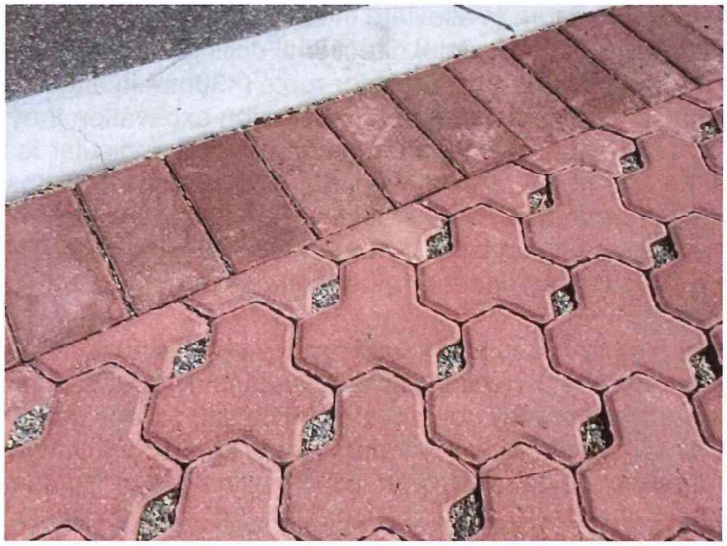


Figure 9. **Where hard surfacing is proposed adjacent/ within the TPZ of mature existing trees the use of permeable paving provides an option to alleviate the negative impacts of reduced water infiltration and aeration to the absorbing roots (that are responsible for the uptake of the water and nutrients, and which require oxygen).**

Figure 10. **Example of air-spading and soil vacuum to remove soil within the tree protection zone without damaging or severing tree roots, thereby allowing a root-sensitive excavation technique for the installation of below-ground services beneath the rootplate.**

3.10 Where the objective is to retain the assessed trees for the long term the following is advised (pre-design/ construction):

- Crossover construction and associated activities such as excavation and soil cut or fill should not occur within the tree protection zone (TPZ) radius of the rootplate of each tree, to avoid compromising tree health by loss of the absorbing roots and to avoid compromising tree stability by the loss of or damage to the large woody roots. Where minor encroachment into the TPZ is required due to the location of the crossovers and site constraints, it should be done so using root-sensitive excavation techniques such as air spading, hand digging or soil vacuum to alleviate the potential for rootplate damage.

- Encroachment and excavation resulting in root severance must be excluded entirely from the structural root zone (SRZ) of each tree, with the approximate SRZ radius measurement calculated from the trunk diameter x 5 i.e. 40cm x 5 = 2m SRZ radius. Where possible, the proposed crossovers should be located outside the SRZ of each tree, to alleviate the potential for rootplate damage and to mitigate the likelihood of root/ crossover conflicts in the future i.e. root thickening and diameter increase as part of normal root growth may displace adjacent hard surfacing. To achieve crossover exclusion from the SRZ consideration could be given to narrowing the proposed crossover width to allow single vehicle traffic only.

- Whilst less desirable, the use of minor fill soil (approximately 200mm depth) atop the existing grade may provide an option for the base of the proposed crossovers. Such fill soil must be applied without excavation/ root severance and the soil must be kept of the trunk basal area of the trees. Where machinery is used, it is imperative that protective fencing is erected prior to avoid collision impact and trunk injury.

- Beyond the SRZ but still within the TPZ, where minor encroachment/ excavation is required it should be undertaken using root sensitive excavation techniques such as hand-digging or soil vacuum to avoid damaging tree roots. Continuous open trenching must be avoided. Furthermore, spanning pathways/ low-block wall structures across the rootplate of the trees provides the best option to mitigate root damage and subsequent tree stress. All tree roots greater than 30mm in diameter revealed in excavation works beyond the SRZ should be retained where possible or pruned cleanly with a handsaw to promote adequate wound occlusion.

- Where underground services/ utilities/ drainage/ irrigation etc. are proposed within the TPZ of the trees, they should be excluded from the SRZ where possible. For underground service installation, the use of trenchless technology or horizontal directional drilling provides options to preserve tree roots and alleviate negative impacts. For drainage/ irrigation installation, hand digging or soil vacuum provides a root

sensitive excavation option and poly/ PVC pipes can be inserted manually beneath the rootplate of the trees.

- With construction of the crossovers potentially reducing water/ rainfall infiltration into the rootplate of the trees, it is recommended that turf/ garden beds, or permeable paving be used within the TPZ area of the trees where it extends into the front setback of the adjacent properties, to alleviate the potential for increased storm water run-off and associated negative impacts (reduced soil moisture) for the trees.

- Where construction activities/ excavation are proposed during the hot, dry months an irrigation regime such as a drip watering system at the TPZ periphery of each mature tree should be implemented and maintained. Additionally, the application of composted wood chip mulch (50-100mm depth) atop the ground surface within the tree protection zone radius can be used to reduce evapotranspiration and subsequent tree stress.

3.11 Assessment/ Recommendations Summary

Tree #	Species	Retention Value	TPZ radius	SRZ radius	Recommendations
1	marri	High	7.9m	3.3m	Crown lifting
2	marri	High	15m	6.3m	Deadwooding, crown lifting
3	marri	High	13.8m	5.8m	Deadwooding, crown lifting
4	marri	Low	3.7m	1.6m	Consider removal for crossover
5	marri	Medium	5.4m	2.3m	Consider removal for crossover
6	marri	Medium	4m	1.7m	No work required at present
7	marri	Medium	5m	2.1m	No work required at present
8	marri	Medium	8.4m	3.5m	Deadwooding, crown lifting
9	marri	Low	4.6m	1.9m	Consider removal for crossover
10	marri	Medium	11m	4.6m	Crown lifting
11	marri	High	9.1m	3.8m	Crown lifting
12	jarrah	High	6.2m	2.6m	No work required at present
13	marri	Medium	3.7m	1.6m	Crown lifting
14	jarrah	High	6.2m	2.6m	No work required at present
15	marri	High	7.8m	3.3m	Crown lifting

Table 1. Summary of tree retention value and remedial pruning/ removal options for the 15 trees where occupancy by people and property is expected to increase as part of the proposed development.

Figure 11. **Tree numbers 4 & 5 (see arrows) where located within the middle section of the proposed crossover, with tree retention as part of crossover construction not likely; looking towards the southeast.**

Figure 12. **Significant trunk lean was evident for tree number 9 (see arrow) and as such is not likely to allow vehicle traffic to pass within the dripline of the tree; looking towards the south.**

4.0 Appendix I

4.1 Arboricultural Terminology

4.2 Crown – the leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree, whilst crown lifting involves pruning of the lower branches to improve clearance for buildings, pedestrians, vehicles etc.

4.3 DBH - diameter of the main trunk, measured at breast height approximately 1.4m above ground level for urban trees.

4.4 Deadwooding – the removal of dead, diseased or damaged branch wood from the crown of the tree, as well as any broken and lodged branches.

4.5 Dripline – the width of the crown of the tree measured by the lateral extent of the foliage, with the crown spread measurement indicating the widest part.

4.6 Fall zone – is the area in which the tree or tree part is likely to fall when it fails, often calculated as 1.5 times the tree height where brittle dead branches etc. may break up and scatter debris.

4.7 First order structural branch – the large branches arising from the trunk that form the main structure of the crown.

4.8 Reduction prune – pruning to reduce/ shorten the length of a branch where excessive end weight or extension is evident, back to a lateral branch that is at least one-third the diameter of the branch being removed.

4.9 Root collar – area at the base of the tree were the roots and trunk merge.

4.10 Targets – an object, person or structure that would be damaged or injured in the event of tree or branch failure is referred to as the target or target zone. The hazard evaluation of the target zone is relative to the expected use and occupancy of that area.

4.11 Topping and Lopping – deleterious tree height and branch reduction work often at indiscriminate points and generally resulting in weakly-attached regrowth branches prone to failure as subsequent growth occurs.

4.12 Tree Protection Zone (TPZ) – the zone of the root plate most likely to contain roots that are critical for anchorage and stability, as well as the absorbing roots responsible for the uptake of water and nutrients; with the radius measurement calculated as trunk diameter (DBH) x 12.

4.13 Useful life expectancy (ULE) – age ranges for retention based on condition.

4.14 V-shaped union – ingrown bark from adjacent parts of the tree that are in contact with each other; usually branch forks, acutely-angled branch attachments or basal stems – often a high failure potential.

4.15 Tree Structure and Health

4.16 The structural condition ('Structure') for each tree or group of trees has been assessed using the following qualitative criteria:

- Good – generally free of structural defects
- Fair – defects evident that may be typical for the species and age class, and which could be corrected through remedial pruning works
- Poor – significant defects that are not likely to be corrected through remedial pruning or arboricultural works
- TBA – to be assessed, requiring further investigation to evaluate tree structural condition

4.17 The vitality ('Health') for each tree or group of trees has been assessed using the following qualitative criteria:

- High – consistent crown density and foliage colour, good shoot extension and an insignificant number of naturally-occurring internal dead branches
- Average – crown condition that may representative for the species and/ or seasonal, possessing satisfactory shoot extension and/ or minimal decline and dead branches
- Low – poor shoot extension, sparse crown density and not likely to be corrected through improvement of site resources and plant nutrition
- Moribund – final stages of a decline spiral

4.18 Retention Value

4.19 The retention value for each tree has been based on a qualitative assessment of current tree structure and health condition, the useful life expectancy, and the potential for the tree or group of trees to contribute benefits such as shade to the site as part of any proposed upgrade i.e. tree/s of good structure, high vitality, and assessed as having a long useful life expectancy without the requirement for extensive management works to maintain the tree, are subsequently allocated a high retention value. Retention value classes include high, medium, low.

4.20 Tree Risk Assessment

4.21 Tree risk assessment was undertaken using the International Society of Arboriculture Tree Risk Assessment (TRAQ) method, which derives an estimate of risk following consideration of targets, the likelihood of failure, the likelihood of that failure impacting a target, and the consequences of the failure. The risk process defines risk rating categories and uses a risk matrix to rate the level of risk based on likelihood and consequence ratings within a twelve-month timeframe. Subsequently, a risk rating of low, moderate, high or extreme is derived. The target (people or property) that could be injured or damaged following the proposed development has been assumed and as such the risk rating provides a guide only.

5.0 Appendix II

5.1 Author Formal Qualifications

5.2 Bachelor of Science (Sustainable Forestry) – 2012
Edith Cowan University, Joondalup & Murdoch University, Murdoch, WA.

5.3 Diploma of Applied Science (Horticulture) – 2000
Major studies Arboriculture and Parks/ Gardens management
University of Melbourne, Burnley campus, VIC.

5.4 Certificate IV (TAE40110) in Training & Assessment – 2014
Plenty Training, Robina, QLD.

5.5 Certificate of Horticultural Practice – 1994
Challenger TAFE, Murdoch campus, WA.

5.6 Additional Certifications

5.7 ISA Certified Arborist Municipal Specialist (AU-0020AM) – 2012 (recertified 2018)
International Society of Arboriculture
www.isa-arbor.com/certification/benefits/credentialsExplained.aspx

5.8 ISA Tree Risk Assessment Qualification (TRAQ) – 2013 (recertified 2018)
International Society of Arboriculture
http://www.isa-arbor.com/certification/becomequalified/becomequalified.aspx

5.9 Limitation of Liability

5.10 Bowden Tree Consultancy are tree specialists who use their qualifications, education, knowledge, training, diagnostic tools and experience to examine trees, recommend measures to enhance the beauty and health of trees, and attempt to reduce the risk of living near trees. Clients may choose to accept or disregard the recommendations of this assessment and report.

5.11 Bowden Tree Consultancy cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that fail in ways that the arboriculture industry does not fully understand. Conditions are often hidden within trees and below ground. Unless otherwise stated, observations have been visually assessed from ground level. Bowden Tree Consultancy cannot guarantee that a tree will be healthy or a low risk of harm under all circumstances, or for a specified period of time. Likewise, remedial treatments cannot be guaranteed.

5.12 Treatment, pruning and removal of trees may involve considerations beyond the scope of Bowden Tree Consultancy's service, such as property boundaries and ownership, disputes between neighbours, sight lines, landlord-tenant matters and other related incidents. Bowden Tree

Consultancy cannot take such issues into account unless complete and accurate information is given prior or at the time of the site inspection. Likewise Bowden Tree Consultancy cannot accept responsibility for the authorisation or non-authorisation of any recommended treatment or remedial measures undertaken.

5.13 In the event that Bowden Tree Consultancy recommends retesting or inspection of trees at stated intervals, or installs any cable/s, bracing systems and support systems, Bowden Tree Consultancy must inspect the system installed at intervals of not greater than 12 months, unless otherwise specified in written reports. It is the client's responsibility to make arrangements with Bowden Tree Consultancy to conduct the re-inspection.

5.14 Trees can be managed, but they cannot be controlled. To live or work near a tree involves a degree of risk. All written reports must be read in their entirety; at no time shall part of the written assessment be referred to unless taken in full context with the whole written report. If this written report is to be used in a court of law, or any other legal situation, Bowden Tree Consultancy must be advised in writing prior to the written assessment being presented in any form to any other party.

5.15 Business Details

5.16 Bowden Tree Consultancy®
ABN: 51925884945
Post Office Box 104 DARLINGTON W.A. 6070
M: 0438 936 679
E: info@bowdentree.com.au
W: www.bowdentree.com.au

5.17 Literature Cited

5.18 Ball, D.J. & Ball-King, L. (2011). *Public Safety and Risk Assessment.* Great Britain: Earthscan

5.19 British Standards Institution, (2012). *BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations*, London: BSI Group

5.20 Lilly, S., Matheny, N. & Smiley, E., (2011). *Best Management Practices - Tree Risk Assessment*, Champaign, IL: International Society of Arboriculture

5.21 Mattheck, C., &. Breloer, H. (1994). *The Body Language of Trees - A Handbook for Failure Analysis*. London, England: The Stationery Office.

5.22 Standards Australia, (2009). *AS4970-2009 Protection of Trees on Development Sites*, Sydney: SAI Global

6.0 Appendix III

6.1 Tree Attribute Data

Tree #	Botanical Name	Common Name	Height	DBH	Crown Spread (NS/EW)	TPZ radius (m)	SRZ radius (m)	Structure	Health	ULE	Retention Value	Comments	Risk Rating	Remedial Pruning Options
1	*Corymbia calophylla*	marri	17m	0.66m	10/11m	7.9	3.3	Fair	High	40yrs+	High	Previous reduction pruning works evident on the north side to clear powerlines, naturally occurring dead branches to approximately 30mm diameter visible, several low branches observed	Low	Crown lifting
2	*Corymbia calophylla*	marri	23m	1.25m	13/14m	15	6.3	Fair	High	15-40yrs	High	Bifurcation at the trunk basal area into two codominant stems visible, Previous reduction pruning works evident on the north side to clear powerlines, naturally occurring dead branches to approximately 100mm diameter visible, several low branches observed	Moderate	Deadwooding, crown lifting
3	*Corymbia calophylla*	marri	22m	1.15m	14/9m	13.8	5.8	Fair	High	15-40yrs	High	1.9m east of crossover peg, pruning wound evident at union of cocominant stems at the trunk basal area, previous reduction pruning visible on north side to clear powerlines, several low branches, naturally occurring dead branches to approximately 70mm diameter observed	Moderate	Deadwooding, crown lifting
4	*Corymbia calophylla*	marri	10m	0.31m	4/5m	3.7	1.6	Poor	Average	5-15yrs	Low	Suppressed, large diameter pruning wounds visible within the lower crown,	Low	Consider removal for crossover

5	*Corymbia calophylla*	marri	24m	0.45m	8/5m	5.4	2.3	Fair	High	15-40yrs	Medium	1.4m east of crossover peg (within crossover), extensive reduction pruning works observed, upper crown foliage concentration, dead branches nominal in size and amount	Low	Consider removal for crossover
6	*Corymbia calophylla*	marri	21m	0.33m	5/4m	4	1.7	Fair	High	5-15yrs	Medium	0.6m west of crossover peg, lean and concentration of foliage towards the north, dead branches nominal in size and amount	Moderate	No work required at present
7	*Corymbia calophylla*	marri	24m	0.42m	6/4m	5	2.1	Fair	Average	15-40yrs	Medium	Suppressed lower crown branch development, dead branches nominal in size and amount	Low	No work required at present
8	*Corymbia calophylla*	marri	21m	0.7m	10/9m	8.4	3.5	Fair	Average	5-15yrs	Medium	0.2m east of crossover peg, significant marri canker infection evident, dead and declining branches to 100mm diameter observed, lean towards the southwest	Moderate	Deadwooding, crown lifting
9	*Corymbia calophylla*	marri	6m	0.38m	4/6m	4.6	1.9	Poor	High	5-15yrs	Low	Significant trunk lean west and low height over proposed crossover	Low	Consider removal for crossover
10	*Corymbia calophylla*	marri	19m	0.92m	8/7m	11	4.6	Fair	High	15-40yrs	Medium	0.4m west of crossover peg, pruning wounds evident at the trunk basal area and adjacent to the union of the codominant stems, dead branches nominal in size and amount, several low branches observed	Moderate	Crown lifting
11	*Corymbia calophylla*	marri	19m	0.76m	7/7m	9.1	3.8	Good	High	40yrs+	High	0.6m east of crossover, subordinate stem evident arising from the trunk basal area and likely to conflict with proposed crossover traffic, dead branches nominal in size and amount	Low	Crown lifting
12	*Eucalyptus marginata*	jarrah	13m	0.52m	9/11m	6.2	2.6	Fair	High	40yrs+	High	1.8m west of crossover peg, extensive reduction pruning works observed, dead branches to approximately 30mm diameter visible, minor	Low	No work required at present

												epicormic regrowth branches observed		
13	*Corymbia calophylla*	marri	8m	0.31m	6/7m	3.7	1.6	Poor	High	15-40yrs	Medium	2.1m east of crossover peg, suppressed crown development, large pruning wounds evident at the trunk basal area, several low branches visible	Low	Crown lifting
14	*Eucalyptus marginata*	jarrah	11m	0.52m	8/8m	6.2	2.6	Fair	High	40yrs+	High	2.1m east of crossover peg, significant lean and crown development towards the west, dead branches to approximately 40mm diameter observed	Low	No work required at present
15	*Corymbia calophylla*	marri	14m	0.65m	7/9m	7.8	3.3	Fair	High	40yrs+	High	Extensive reduction pruning works observed, several low branches observed on the south side and likely to conflict with proposed crossover traffic, minor epicormic regrowth branches visible, dead branches to approximately 40mm diameter observed	Low	Crown lifting

Attachment 3: Assessment against the Ten Clearing Principles

Principle Number	Principle Description	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	The proposed clearing area comprises of 5 mature Marri trees within a patch of City managed street verge. The site has no understorey and no other supporting vegetation. As a result there is limited biodiversity within the proposed clearing area.	The proposal is not at variance with Principle A.
(b)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	There is limited Black Cockatoo potential breeding or roosting habitat associated with the trees proposed to be cleared. The proposed clearing will remove less than 350m2 of low quality potential Black Cockatoo foraging habitat, and the removal of one tree large enough to be considered a potential breeding tree (and with no identified hollows). As a result, significant impacts to Black Cockatoo habitat are unlikely. The site is also nearby to better quality vegetation and refuge within Creyk Park, therefore the proposed clearing is unlikely to have a significant impact on fauna.	The proposal is unlikely to be at variance with Principle B.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.	There are no known Threatened or Priority flora within or adjacent to the proposed clearing area.	The proposal is not at variance with Principle C.
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.	There are no known Threatened or Priority Ecological Communities within or adjacent to the proposed clearing area. The proposed clearing area is within the buffer of a TEC, however the minimal amount of clearing required will not significantly impact any TEC.	The proposal is not at variance with Principle D.
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The vegetation within the proposed clearing area is degraded, and comprises low diversity. Given the small amount of clearing proposed it is highly unlikely to have a significant negative impact.	The proposal is not at variance with Principle E.
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no wetlands or watercourses within or adjacent to the proposed clearing area.	The proposal is unlikely to be variance with Principle F.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	A total of 5 mature trees is proposed to be cleared, with 10 adjacent mature trees to be retained. Therefore, the land proposed to be cleared is	The proposal is not at variance with Principle G.

Principle Number	Principle Description	Assessment	Outcome
		minimal, and already considered to be degraded. The cleared area will also be replaced constructed crossovers for the most part; therefore the proposed clearing will not result in land degradation.	
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The proposed clearing area is approximately 30m east of Creyk Park. Clearing will not result in any impacts to his reserve.	The proposal is not at variance with Principle H.
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	There are no wetlands or natural watercourses within the proposed clearing area. Detailed design has considered and accounted for water runoff management.	The proposal is not at variance with Principle I.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	Given the minimal proposed clearing area, clearing is not considered likely to cause, or exacerbate the intensity of flooding. Any potential for localised flooding will be managed through design.	The proposal is not at variance with Principle J.