urban forest and greening study

July 2022

PROJECT

Redfern - North Eveleigh Paint Shop Sub-Precinct

Redfern, NSW 2015

CLIENT

Transport for NSW

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DOCUMENT CONTROL

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Acknowledgements & Qualifications

This document has been prepared by Arterra Design Pty Ltd, using the expertise of our in-house consulting arborists (AQF Level 5), Robert Smart and (AQF Level 5), Chloe Bristow. Robert Smart is a member of the International Society of Arboriculture - Australian Chapter and also a Registered Consulting Arborist with Arboriculture Australia and a licenced Quantified Tree Risk Assessment practitioner. Robert Smart has 25 years experience in managing trees in complex development sites. Robert is also a Registered Landscape Architect with over 30 years experience.

Disclaimer

This document is only to be used in relation to the Redfern North Eveleigh - Paint Shop Sub-Precinct and is only to be used for the purpose for which it was commissioned and in accordance with the specific brief and contract between Arterra Design and Transport for NSW. Arterra Design accepts no liability or responsibility whatsoever for or in respect of any use of, or reliance upon, this report and its supporting material by any third party.

The following limitations apply to this report: -

1. It is a strategy document: and is to provide guidance to the current and future project urban designers and planners. The guidance is based on brief site inspection of all trees, in some limited cases undertaken at some distance from the trees due to restrictions in access to parts of the site. It will be necessary to undertake further detailed site investigations once the exact nature and extent of the proposed site works are known for each individual construction project.
2. Plans: All plans are based on provided information and are illustrative for planning purposes only. They should only be used relating to urban forest and green infrastructure planning issues and are not suitable for any other purpose.
3. Further consultation on tree related issues: We advise against any detailed designs based on this information being submitted for construction approval without the relevant tree related issues being further reviewed by Arterra or another suitably qualified consulting arborist.
4. Trees outside the precinct / sub-precinct are not specifically addressed as part of this report.
5. Timing : Written at a point in time with no consideration for changes to other projects outside the study boundary. Tree assessment was undertaken in 2019. Tree removal, failure or planting since this time is not captured in this reports statistics or plans.

CONTENTS

i EXECUTIVE SUMMARY

This study has been prepared primarily to address the NSW Department of Planning and Environment (DPE) study requirements. It analyses the existing tree population and identifies the green infrastructure opportunities and constraints associated with the proposed redevelopment of the Redfern North Eveleigh project, specifically, the Paint Shop Sub-Precinct. It is intended to provide Transport for NSW (Transport) and the current and future design consultants with information that clearly identifies and ranks the trees that are most appropriate to retain and protect, and outlines the broad methodology on how to potentially retain and protect them successfully. It also provides the broad strategies proposed to expand and enhance the urban forest and other green infrastructure creating a diverse, sustainable, attractive and robust urban environment into the future.

What is Green Infrastructure and the Urban Forest?

'Green infrastructure' consists of all trees and vegetation located within a defined urban area, irrespective of the species, origin (native, exotic), location (street, park, garden) or its ownership (public, private, institutional). Green infrastructure is a City's natural life support system and essential for all its functions. There is growing realisation, backed by a very rapidly increasing body of local and international research, that green infrastructure sustains and enhances human health and well-being. We need to be proactive in sustaining our City's existing natural assets, or we risk losing them.

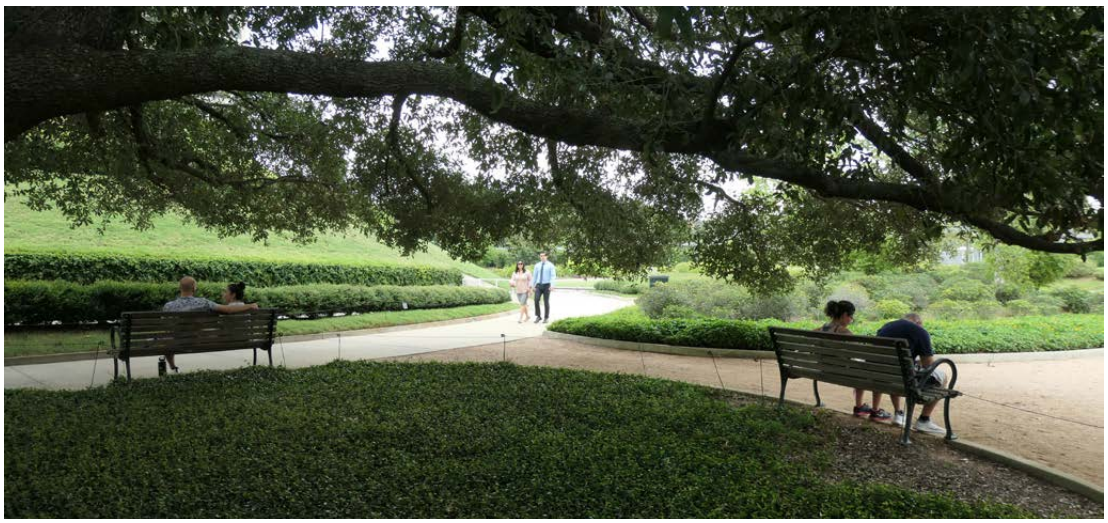

Figure i.1 – Trees are one of the hardest working, multi-tasking assets within our city's green infrastructure. (Photo: Arterra)

The 'urban forest' is a major and vital component of our city wide 'green infrastructure' and does much of the heavy lifting, along with other key elements such as green roofs, in achieving the multiple benefits urban greening can provide. The urban forest is often most easily measured as a canopy cover percentage of the land area being studied (LGA NSW 2003). It is one integral component of a complex built environment that includes roads, car parks, footpaths, underground services, buildings and other urban structures (North Sydney 2011).

In practice, green infrastructure incorporates and encompasses all vegetation within our streets, parks, wetlands, balconies, facades and roofs. This document addresses greening infrastructure as a whole, but due to the very urban nature, has a strong focus on addressing the existing and the proposed tree stratum associated with the Paint Shop Sub-Precinct.

Key Environmental Challenges We Are Facing

We have several significant sustainability challenges facing the planet and the sustainability of our urban living in the coming decades. These include:

- Combating and adapting to inevitable **climate changes** and excessive global warming and in particular manifested in urban heating.
- Creating **healthy urban environments** that contribute to our wellbeing both physically and mentally.
- Rapid movement to **carbon neutrality** through reduced green house gas emissions, capture and storage of atmospheric carbon and significant changes to our modes of transport and resource consumption.
- Reduced world-wide **biodiversity** and natural resources affecting inherent ecological health and sustainability.
- Increased **water and food** scarcity.

Key Objectives Proposed for the Paint Shop Sub-Precinct

The keys to addressing most of these serious issues are already well known and at our finger tips. This includes listening to, and embracing our indigenous culture's '**caring for country**' ethos and meaningfully increasing our urban areas green infrastructure; particularly through quality and sustainable **tree planting** and significantly greater adoption of **green roofs and other sustainable landscaping**.

The following outlines the key initiatives proposed to be adopted for this project, at both a planning level and at implementation:

- **Retain and protect** the few important and existing trees on the site such as those close to the CME building and along Wilson Street.
- **Remove weed** species and undesirable plants to remove potential ongoing weed sources, lack of biodiversity and urban maintenance burdens.
- Expand and enhance the urban forest and **canopy coverage** while respecting the need to maintain the industrial heritage and important views to heritage buildings.
- **Improve biodiversity** by reinstating some key species from the endangered ecological communities that would have once graced the site such as the Turpentine Iron Bark Forest and Eastern Suburbs Banksia Scrub
- Utilise a mixture of species of trees shrubs and ground covers to provide **diversity** of sizes and habitat and address specific urban design outcomes such as dense summer shade, winter sun, wind mitigation appropriate scale and heights to address the future built forms.
- Utilise vegetation, and due to their longer life spans, particularly trees, that can tolerate and prosper in the forecast **warmer climate** of Sydney, in 50 to 100 years time.
- Incorporate vegetation that contributes meaning and **significance to indigenous** cultures.
- **Mitigate urban heat** affects through increased canopy cover and via the active promotion of 'greening' at the ground level and on roof tops and building podiums.
- Promote and encourage **precinct-scale and highly integrated approaches to water management**, particularly focussed on passive irrigation and collection of rainwater and grey water for the long term irrigation and sustenance of green infrastructure.
- Create **shaded walkways and streets** that promote active recreation and transport and minimise urban heat absorption and re-radiation.

To achieve the above, the key site constraints that need to be overcome and pro-actively dealt with are:

- Poor existing site **soil conditions** and creating suitable growing environments for trees and greening.
- Avoiding detracting from the important **industrial heritage**.
- Avoiding creating unacceptable **risks** or tree growth that may impact on the active function of the adjoining major rail corridor.
- Collecting, storing and distributing sufficient **water** to sustain 'greening' initiatives in the longer term.
- Maintaining appropriate ground levels and minimising disturbance around **existing trees** to be retained.

Figure i.2 – Artist impression of the completed project. (Source: Bates Smart / Turf Studio)

The Key Targets and Controls Proposed for the Paint Shop Sub-Precinct

There are significant opportunities to protect and enhance the existing urban forest. Research has indicated that urban tree canopy is often far more important than other forms of greening. Some key targets and controls to be imposed for the Sub-Precinct are outlined below. The Sub-Precinct should aim to achieve:

- A minimum of **40% 'green cover**' within the study area (this is 'all' greening including ground level planting, lawns, roof tops, podiums and tree canopy coverage, both existing and ultimate).
- A minimum of **25% 'tree canopy cover**', helping to contribute to wider CoS targets, while respecting the significant industrial heritage aspects of the Sub-Precinct.
- Protection of the most **significant existing trees** on the site and incorporate them as mature elements within the proposed landscapes. They can provide an important and instant framework for streets and new parks and green spaces. Recognise that mature trees require space around them to protect their roots and therefore it will be necessary to minimise buildings, level changes or service trenching through any areas retaining trees. It is possible to include suspended structures or walkways around existing trees, if very sensitively designed.
- A minimum of **50% green roofs** and podium level planting. All new buildings should be provided with some form of green roof or podium landscaping with a view to achieving a precinct wide average of 50% green roof coverage across the new buildings (for example, either 50% of the new buildings are provided with an extensive green roof or new buildings applying green roofs to at least 50% of their roof/podium areas). We note that there should be no mandated expectation to have green roofs on any existing heritage buildings.
- Extensively **collect and re-use a majority of rainwater** and a substantial component of the Sub-Precincts generated grey water to irrigate and sustain the expected green infrastructure, both public and private. Also direct surface water and runoff, wherever technically possible, towards existing and new trees and other green infrastructure to **passively irrigate** the plants in an ever-warming climate with frequent droughts.
- Clear guidance and promotion of **holistic street profile designs** to work trees in as one of the core elements of the design, not an after-thought. Space, both above and below ground, is the key. It is essential to consider final sizes of root plates, trunks, and canopy. The provision of suitable surface areas around the trees is often more critical than excessive soil depths.
- Adequate **soil volumes** for all new tree planting with the minimum expectations clearly conveyed and promoted in the planning and design guideline outcomes.
- Planting of the majority of new trees in **natural soils** rather than relying too heavily on podium or on-structure planting. However, efforts should still be made to incorporate appropriate trees into upper levels of built forms and podiums and on roof tops to further improve canopy coverage and increase connections to nature.

- Opportunities for **community orchard style planting** and implementation of urban agriculture in semi-public open spaces/ roof terraces/ podiums to provide urban food and community engagement with trees and greening.
- Incorporate a **diverse range of species** into the final designs to increase resilience and diversity and achieve the commonly accepted targets of no more than:
    - 40% in any one family,
    - 30% in any one genus,
    - 10% in any one species.
- Achieve a mixture of trees from **at least 3 different botanic families** for all major internal streets and park planting.
- Achieve an **offset ratio of 3 to 1** for any existing trees removed. This being 3 trees to be replanted for each tree removed.
- Achieve a **diversity of tree sizes** with a minimum of;
    - 10% civic scale trees (extra large in canopy and / or height)
    - 30-35% large trees
    - 50-55 % medium trees
    - And no more than 10% small trees,
- Use of large **civic-scaled trees** such as Figs, Araucarias, Eucalypts and Agathis ahead of numerous smaller trees to:
    - maximise canopy cover versus resource allocation,
    - free up views to heritage buildings and facades,
    - provide vegetation that is better in scale with proposed and existing buildings,
    - provide landmarks at key visual points,
    - allow trees to be seen out of windows even many storeys above ground level.
- Use of species that currently **prosper in slightly warmer climates** to cater for climate change. (For example *Araucaria* sp, *Ficus sp. Caesalpinia ferrea*, *Harpullia pendula*, *Tabebuia impetiginosa*) and look to use trees and plants that continue to transpire during extreme heat to maximise urban heat mitigation during heat waves and summers.
- Incorporation of **some deciduous trees and vines** at appropriate locations to provide for required winter solar access and human comfort during cooler months.
- Use of suitable trees for **wind amelioration**, understanding the most desirable forms, sizes, and densities of tree canopy in given locations. Larger trees with a denser canopy are probably more important than smaller trees or trees with very open canopies, in this regard. Coniferous plants are particularly good in this regard due to their inherent biology, wood production characteristics and structure.

Figure i.3 – Existing trees are important assets. We must design to retain and utilise them and not expect them to conform to the cities needs. They are living and natural organisms and need to be supplied with the basics of life in order to prosper and provide the myriad of benefits we demand. (Photo: Arterra)

- Use appropriate **setback zones** near the buildings and street kerbs to allow planting of larger trees and always consider a trees ultimate size (including their trunk, root flares, and canopy spreads) without excessive future infrastructure conflicts.
- **Don't over plant** for short-sighted instant effects – as a general rule, allow the planned trees to mature with full and symmetrical canopies where possible. These are easier to manage in the long term, have better health outcomes and improved resilience and are able to be replaced when the time comes without leaving overly misshapen adjoining trees. It also gives the trees more ability to seek adequate resources rather than competing with each other.

In broad terms, the most important thing to consider as part of the planning for the urban forest and greening is that all trees to be retained, and any new trees to be planted within the Sub-Precinct development, must be given the appropriate space to grow and thrive both below ground and above ground, in order for them to continue to develop and prosper for many years. We must start to design our cities for the trees, and not expect the trees to unrealistically conform to the city.

Figure i.4 – Green infrastructure is a vital component of our urban areas and a long term and valuable asset that must be appropriately protected, managed and planned. (Photo: Arterra)

1. INTRODUCTION

1.1 Introduction

The NSW Government is investing in the renewal of the Redfern North Eveleigh Precinct to create a unique mixed-use development, located within the important heritage fabric of North Eveleigh. The strategic underpinning of this proposal arises from the Greater Sydney Region Plan and District Plan. These plans focus on the integration of transport and land use planning, supporting the creation of jobs, housing and services to grow a strong and competitive Sydney.

The Redfern North Eveleigh Precinct is one of the most connected areas in Sydney, and will be a key location for Tech Central, planned to be Australia's biggest technology and innovation hub. Following the upgrading of Redfern station currently underway, the Precinct's renewal is aimed at creating a connected destination for living and working, and an inclusive, active and sustainable place around the clock.

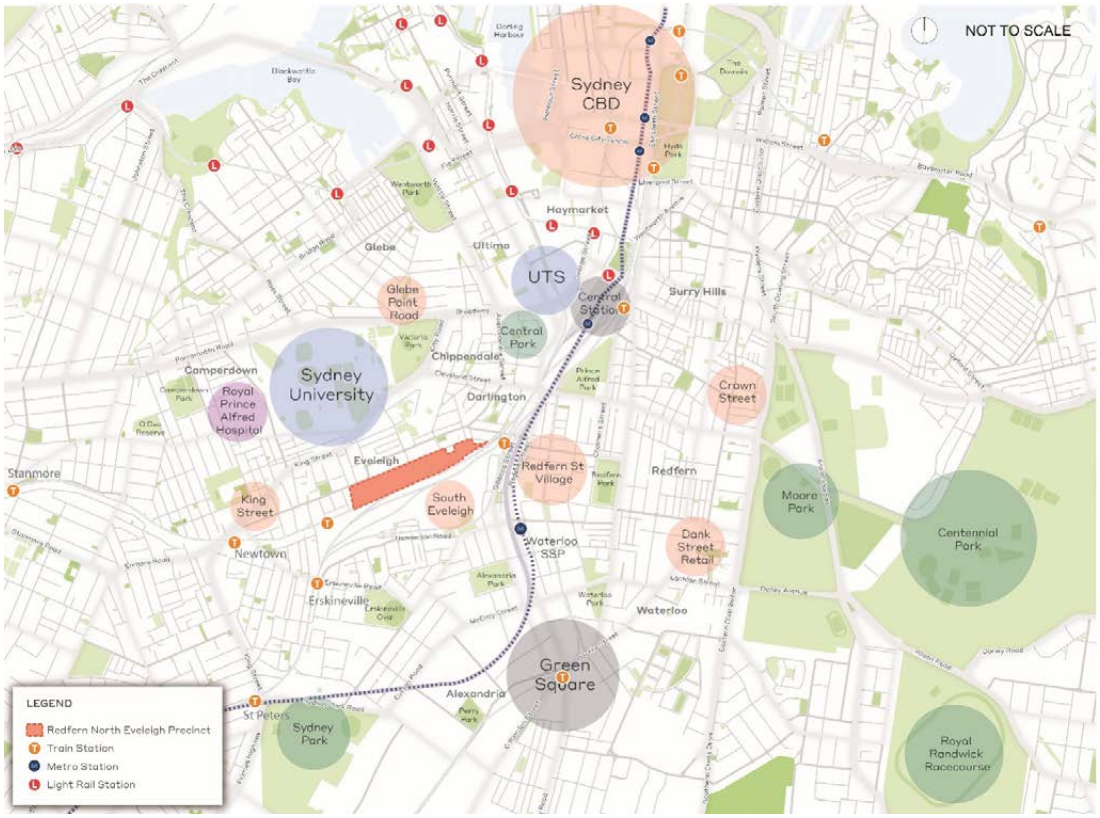

Figure 1.1 - Location plan of Redfern North Eveleigh precinct [Source: Ethos Urban]

The Redfern North Eveleigh Precinct comprises three Sub-Precincts, each with its own distinct character:

- The Paint Shop Sub-Precinct which is the subject of this rezoning proposal;
- The Carriageworks Sub-Precinct, reflecting the cultural heart of the Precinct where current uses will be retained; and
- The Clothing Store Sub-Precinct which is not subject to this rezoning proposal.

This State Significant Precinct (SSP) Study proposes amendments to the planning controls applicable to the Paint Shop Sub-Precinct to reflect changes in strategic direction for the Sub-Precinct. The amendment is being undertaken as a State-led rezoning process, reflecting its status as part of a State Significant Precinct located within the State Environmental Planning Policy (Precincts - Eastern Harbour City) 2021.

The amended development controls will be located within the City of Sydney Local Environmental Plan. Study Requirements were issued by NSW Department of Planning and Environment (DPE) in December 2020 to guide the investigations to support the proposed new planning controls.

1.2 Purpose of this Report and Study Requirements

The purpose of this report is to provide a detailed Urban Forest and Greening Study, including the assessment of the proposed changes, and consider any potential impacts that may result within and surrounding the Paint Shop Sub-Precinct . The relevant study requirements, considerations and consultation requirements, and location of where these have been responded to is outlined in Table 1 below. In broad summary, this study is to:

- Provide an urban forest and greening study and a guiding strategy consistent with the overall objectives sought for the Sub-Precinct and support the overall Redfern North Eveleigh Precinct planning proposals.
- Provide a robust base to inform the current Sub-Precinct Proposals and its future detailed implementation.
- Promote solutions to protect, grow and further enhance the urban forest and other green infrastructure in a way that can be readily implemented and supported by key stakeholders.

With regards to the existing trees, this report discusses the trees that should be considered for retention as part of any new development and provides clear guidelines for the required Tree Protection Zones and other measures to enable the trees to continue to grow and thrive, where they are retained. The schedule of existing trees at Appendix 6.1 of this report provides the numerical Tree Protection Radius for each tree. This should be consulted as more detailed development footprints and building envelopes and landscaping details crystallise beyond the current re-zoning phase of the process.

Green Infrastructure is a complex natural asset and a major natural resources upon which the City relies. As such, detailed planning and collaboration are required by professionals in key allied fields (such as arboriculture, ecology, architecture, landscape architecture, planning, engineering and heritage) to fully deliver urban greening and tree planting that will provide the community with the required environmental, social and economic benefits.

Table 1 – Study Requirements, considerations and consultation

Reference No.	Study Requirement	Section of this Report
9. GREEN INFRASTRUCTURE, ECOLOGY, URBAN FOREST AND GREENING		
Study Requirements		
9.1-1	Identify the existing situation, including constraints, opportunities and key issues.	Refer Section 1.7-1.9 p9-17 Section 2.4 p29 Section 2.5 p34 Section 2.6 p35 Section 2.7 p49 Section 2.8 p51 Section 2.9 p52
9.1-2	Outline the key impacts of the proposals in relation to climate change, heat impacts and community health needs.	Section 3.3 p67
9.1-3	Provide details of the proposed green infrastructure principles and how they will be incorporated into the proposal, illustrating consistency with key policy documents	Green infrastructure principles Section 1.9 p17 & Implementation into proposal Section 3.4 p69 & Section 4.2 p75-80
9.1-4	Include an urban forest and greening strategy - which outlines the percentage (existing and proposed) of greening and canopy cover across each land classification (eg. streets, parks, private land) and private property zoning type. The strategy should include targets for implementing and maintaining green roof and walls where appropriate.	Existing Urban Canopy-p58 Existing Green Cover-p68 Proposed Urban Canopy-p79 Proposed Urban Greening-p79 Targets for Green roofs-p79 and Section 5.4 p103 and the Public Domain Plans prepared by Bates Smart/Turf
9.1-5	Include measures to address stormwater retention management and opportunities for beneficial reuse via various types of green infrastructure	Section 5.5 p105 and p109 more generally and also the related the Public Domain Plans prepared by Bates Smart/Turf and the Utilities and Servicing Strategy by Aecom
9.1-6	Include an 'existing tree' database prepared by a qualified arborist	Refer Section 2.3 p28, Section 2.4 p29 and Section 2.9 p52 and also details of individual trees refer Section 6.1 Schedule of Existing Trees p114.
9.1-7	Include an ecological assessment of the precinct.	Refer p24 and Section 4.4 p83 and separate Ecological Study by WSP
9.1-8	Inform and support the preparation of the proposed planning framework including any recommended planning controls or DCP/ Design Guideline provisions that would deliver an appropriate green infrastructure and sustainability outcome.	Section 5.7 p107
Considerations		
	Relevant case studies and transferable principles that will apply to the proposal.	Refer Section 3.6 p72
	Percentage and distribution of greening and canopy cover across all private (including green roofs and walls) and public domain areas within the precinct.	Refer Section 5.4 p103

	Provision of tree canopy over major pedestrian routes/ desire lines with additional areas of canopy cover over the remaining public places to enable shade and allow cooling of the precinct.	Refer p76-78 and the Public Domain Plans prepared by Bates Smart/Turf
	Retention of existing trees and provision of new trees, the capacity of the proposal to allow for the growth of new trees; the provision of sufficient soil volumes and quality to provide for long term tree health.	Refer Section 5.2 p95 Refer Section 5.3 p97 Refer Section 5.8 p110 Soil Volumes Refer Section 4.8.1 p90
	A tree offsetting strategy.	Refer p68 and Section 5.9 p95 & 109 and Public Domain Plans prepared by Bates Smart/Turf
	Canopy design concepts that improve streetscape amenity.	Refer Section 4.7 p89 Section 4.8 p90
	Access to open space and other community facilities within and beyond the precinct.	Refer Section 4.7 and Public Domain Plans prepared by Bates Smart/Turf
	Taking a whole-of-life approach to green infrastructure through planning design, construction and ongoing precinct management.	Refer Section 4.1 p74 Refer Section 4.5 p83 Refer Section 4.6 p86 Refer Section 4.8 p90
	Impacts on biodiversity and measures to avoid and minimise impacts, protect and enhance biodiversity through the greening of public and private spaces and the retention of existing habitat including habitat provided by built structures.	Refer Section 3.4 p69 Refer Section 3.5 p71 Refer Section 4.1 p74
	The use of a diversity of local native plant species in street tree planting, open space areas and any site landscaping.	Refer Section 5.4.2 p104 and Section 6.2 p118
	The use of advanced sized trees in any street, open space and site landscaping.	Refer Section 5.4.3 p104 Refer Section 5.8.1 p110
	The potential habitat linkage provided by the railway corridor outlined in the City's Urban Ecology Strategic Action Plan, currently under review as an important biodiversity corridor.	Refer p24 and Section 4.4 p83
	Water sensitive urban design and integration with the flood study, plus options for potential alternative water supply.	Refer Section 5.5 p105 and the Environmental Sustainability Report by Arup and the Utilities and Servicing Strategy Report by Aecom and the Public Domain Plans prepared by Bates Smart/Turf
	The Premier's priorities for 'Greening our city' and 'Greener public spaces'.	Refer p26 and p27
Consultation		
	The Study is to demonstrate that it has been undertaken in consultation with the City of Sydney, key agencies, the local community and any other key stakeholders.	Refer Section 2.2 p28 Specific meeting held with CoS on 5 October 2021 regarding Sustainability, Greening and Ecology. Refer also other stakeholder engagement undertaken directly by Transport. Refer to Summary Report by Transport

1.3 Redfern North Eveleigh Precinct

The Redfern North Eveleigh Precinct is located approximately 3km south-west of the Sydney CBD in the suburb of Eveleigh (refer to Figure 1.1). It is located entirely within the City of Sydney local government area (LGA) on government-owned land. The Precinct has an approximate gross site area of 10.95 hectares and comprises land bounded by Wilson Street and residential uses to the north, an active railway corridor to the south, residential uses and Macdonaldtown station to the west, and Redfern station located immediately to the east of the Precinct. The Precinct is also centrally located close to well-known destinations including Sydney University, Victoria Park, Royal Prince Alfred Hospital, the University of Technology Sydney, and South Eveleigh, forming part of the broader Tech Central District.

The Precinct is located within the State Heritage-listed curtilage of Eveleigh Railway Workshops and currently comprises the Platform Apartments with 88 private dwellings, Sydney Trains infrastructure and key state heritage buildings including the Paint Shop, Chief Mechanical Engineer's Building, and the Carriageworks and Blacksmith Shop which provide shared community spaces for events including the Carriageworks Farmers Markets.

A map of the precinct and relevant boundaries is illustrated in Figure 1.2 & 1.3.

1.4 Redfern North Eveleigh Paint Shop Sub-Precinct

The Redfern North Eveleigh Paint Shop Sub-Precinct is approximately 5.15 hectares and is bounded by Wilson Street to the north, residential terraces and Redfern station to the east, the Western Line rail corridor to the south and the Carriageworks Sub-Precinct to the west. The Sub-Precinct has a significant level change from a Reduced Level (RL) height of RL25 metres to RL29 metres on Wilson Street.

The Paint Shop Sub-Precinct currently hosts a number of items of heritage significance, including the Paint Shop Building, Fan of Tracks, Science Lab Building, Telecommunications Building, and Chief Mechanical Engineer's Building. The Sub-Precinct has a number of disused spaces adjacent to the rail corridor as well as functioning Sydney Trains' infrastructure, offices and operational space. Vehicle and pedestrian access to this area is used by Sydney Trains. The site has a clear visual relationship to South Eveleigh and the Eveleigh Locomotive Workshops across the active rail corridor.

A map of the Paint Shop Sub-Precinct and relevant boundaries is illustrated in Figure 1.2 & 1.3.

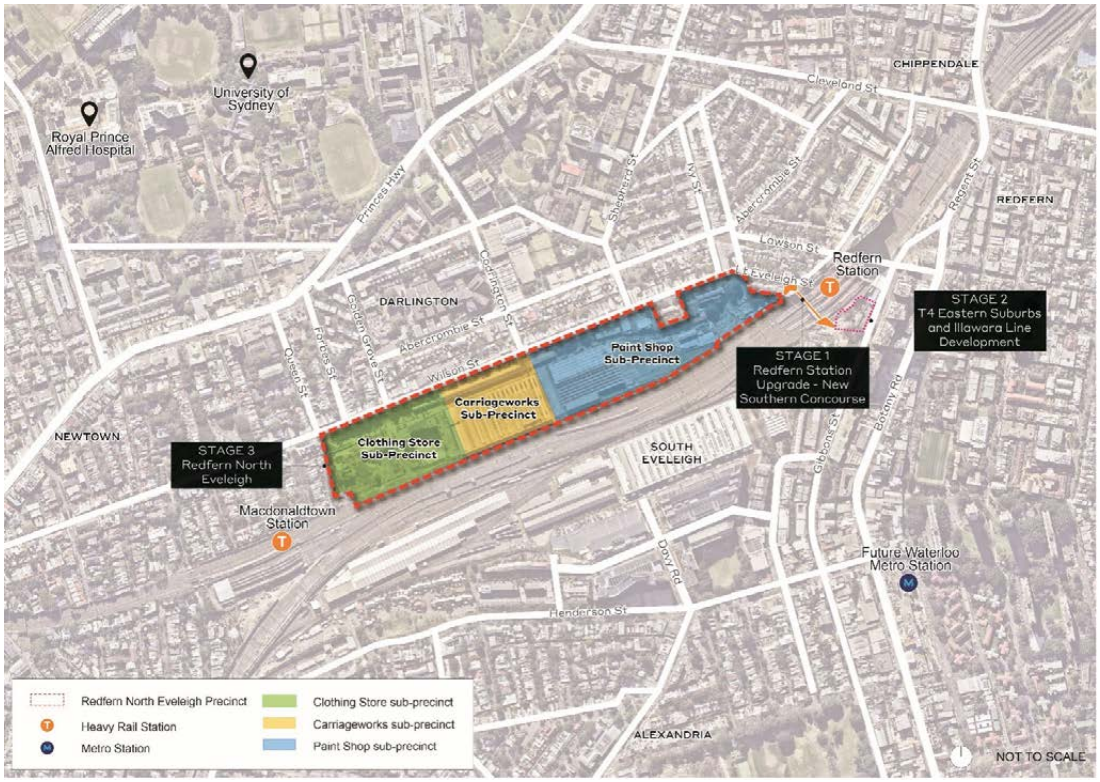

Figure 1.2 - Redfern North Eveleigh and Sub-precincts [Source: Ethos Urban]

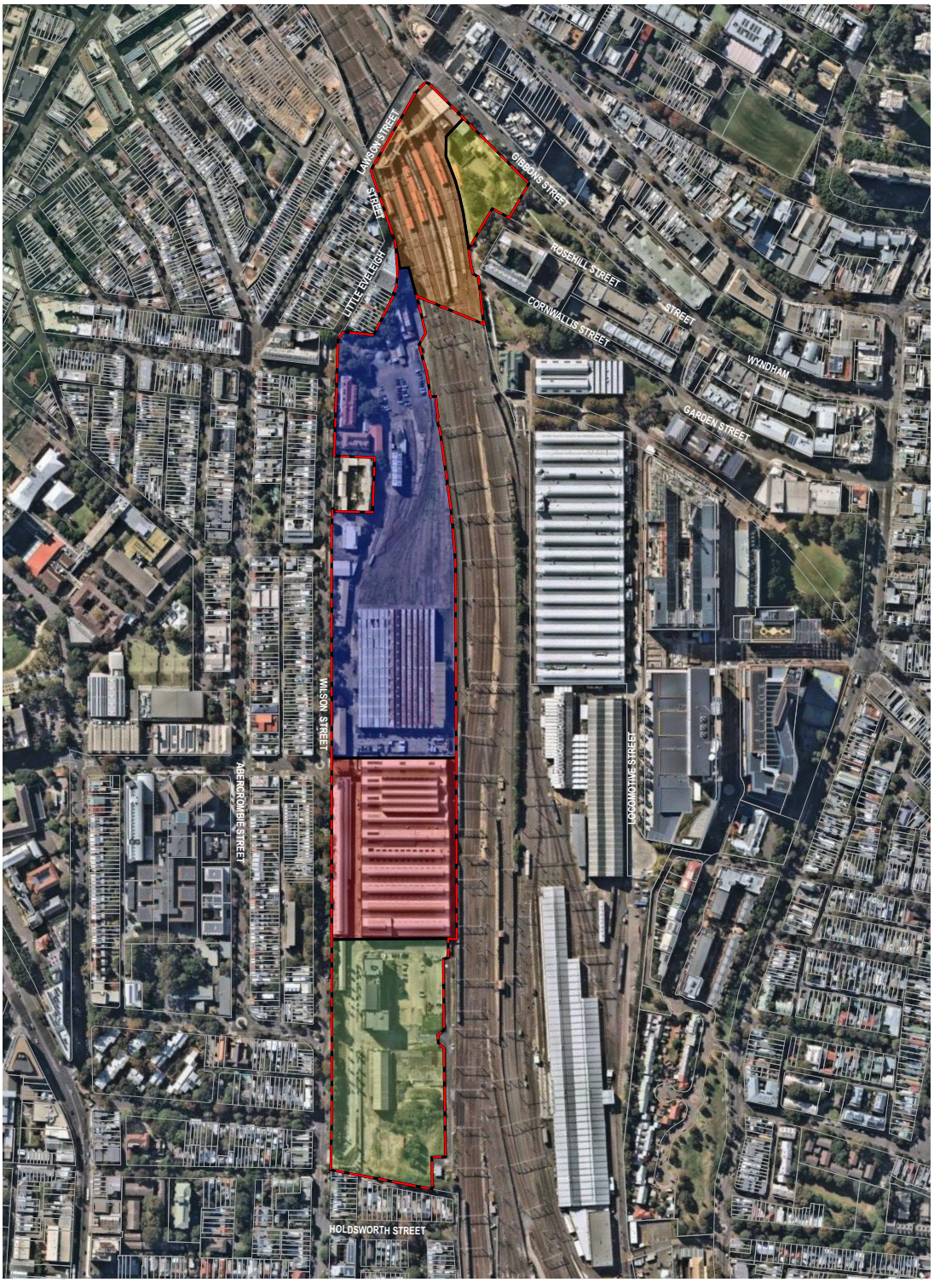

Figure 1.3 - Aerial photograph of the Precinct and the relevant location of sub-precincts relevant to this Study. The Paint Shop Sub-Precinct is the focus of this report. [Source: Arterra]

1.5 Renewal Vision

The Redfern North Eveleigh Paint Shop Sub-Precinct will be a connected centre for living, creativity and employment opportunities that supports the jobs of the future as well as providing an inclusive, active and sustainable place for everyone, where communities gather.

Next to one of the busiest train stations in NSW, the Sub-Precinct will comprise a dynamic mix of uses including housing, creative and office spaces, retail, local business, social enterprise and open space. Renewal will draw on the past, adaptively re-using heritage buildings in the Sub-Precinct and will acknowledge Redfern's existing character and particular significance to Aboriginal peoples, culture and communities across Australia. The Sub-Precinct will evolve as a local place contributing to a global context.

1.6 Indigenous Recognition, Connecting With Country and Urban Greening

In preparing this study, we wish to acknowledge the First People and traditional custodians of the land and waters of the place we now call Sydney. We recognise and acknowledge their great resilience and generosity of spirit towards other peoples with whom they now share their lands and waters. Our cities and urban places are much altered, but traditional wisdom and knowledge in land management can assist in framing the solutions to this site and dealing with the increasing challenges posed by a changing climate (CoS-GSS, 2021).

To be resilient and successful this project's urban forest and green infrastructure and its planning needs to focus on creating a place where everyone, and all living things, can thrive. Quality green spaces, adequate urban tree canopy and water sensitive urban designs have a key role to play in caring for Country.

Never has it been more pertinent to consider our responsibility to look after our Country. As espoused by Elder April Bright "*If you don't look after country, country won't look after you*". Indigenous peoples talk about Country in the same way as they would talk about a person. They speak to Country , they visit Country, worry and grieve for Country and long for Country. To them Country is a living entity with a yesterday, today and tomorrow.

Being charged with the design and implementation our urban spaces, we need to respect, understand and work in partnership with Indigenous peoples in nurturing healthy and stimulating places, and creating landscapes and strategies that align to the spirit and values of 'Country' that are observed by Indigenous people and cultures (Jones, et al, 2018).

Figure 1.4 - Aboriginal scar tree. [Source: SLNSW]

As part of the Redfern North Eveleigh Paint Shop Sub-Precinct proposal, considerable effort have been made to include and incorporate Connecting with Country (CwC) principles and outcomes. The Connecting with Country Framework by Balarinji Studio identifies a range of thematic opportunities that extend beyond the traditional urban design considerations. The Six key CwC themes are:

- Regenerating Country
- Replacing Landmarks
- A Meeting Place
- Legacy of Sydney Trains
- Iconography of County
- Custodianship

These themes have been considered and woven into the wider public domain and urban design outcomes. Relating to the urban forest and greening strategy, the following key elements have been proposed and are considered relevant to the wider project objectives and outcomes.

- **General landscape and urban design strategy** – distinct planting strategies to the upper level and lower level, evoking the underlying geology, hydrology, flora and fauna.
- **Water** – integration of water into the landscape to contribute to identity, support regenerative design approach, and recall Country. Inclusion of bioswales, wetland, 'hanging swamp', and water features.
- **Planting strategy** – integration of endemic plant species (both trees and understorey planting) together with suitable exotic trees that are characteristic and reflective of the sites original period of industry.
- **Green infrastructure generally** – extensive tree canopy and on-structure planting contributing to biodiversity, amenity and healing of the land. Replacement of weed species with native plants.
- **New 'eastern park' around the CME building** - located close to the Station, characterised by extensive indigenous planting with space for informal gathering and community facilities.
- **New Public Square (Paint Shop Square)** – a new open space defined by the industrial heritage (including the fan of tracks), repatriated landforms, extensive endemic planting, water, and new development. This area is connected to, and welcoming, the wider community.
- **Possibilities for incorporation of indigenous food and medicinal plants** – extensive opportunities occur throughout the public domain and particularly within the more private roof gardens and podium landscapes for use of indigenous plants to promote community engagement, education and urban agriculture. Relevant nearby examples of this are the Yerrabingin rooftop garden of South Eveleigh, with similar possibilities being possible within the Paint Shop Sub-Precinct.

Figure 1.5 - Australia's first rooftop farm Yerrabingin weaves Indigenous knowledge and collaborative design. [Source: https://2ser.com/practicing-wayapa-on-australias-first-indigenous-rooftop-farm/]

1.7 A Changing Climate

The United Nations describes climate change as the defining issue of our time. Climate change poses a serious risk to all people, future generations and should be treated as a national emergency. According to the IPCC, we have less than ten years to prevent catastrophic events from happening to human lives. Average global temperatures have increased by 1.2°C above pre-industrial levels, with significant consequences and impacts. Any rise above 2°C would have devastating impacts on Australia, including;

- more extreme weather events,
- reduced rainfall and prolonged droughts,
- longer, hotter and more frequent heatwaves,
- water scarcity,
- more extreme bushfires,
- increased risks to food production,
- reduced biodiversity,
- inundation of coastal areas.

As Australia's climate changes over the next 50-100 years, the species of trees and other plants used in our city today may not be suited to the range of conditions presented by the new climate. Research has found that Sydney's climate would be more like present day Grafton, in less than 30 years.

It is expected that potential water use restrictions and lower than average rainfalls, similar to those Sydney has previously periodically experienced will continue, and potentially worsen, into the longer term. Our trees, in particular, and other green infrastructure will need to be capable of surviving an average drought period, in reasonable condition, and without reliance on valuable potable water supplies.

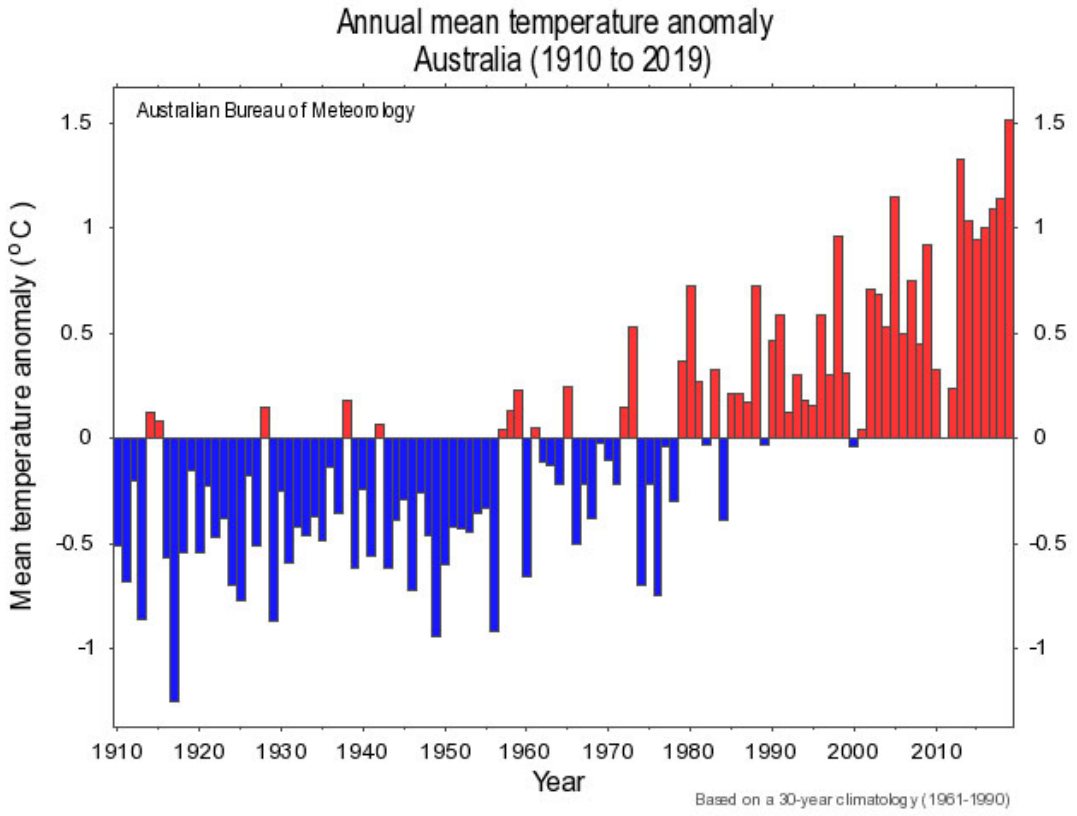

Figure 1.6 - Australian Mean Temperature Anomaly – 1910-2019 [Source: Australian Bureau of Meteorology - 30/1/2020]

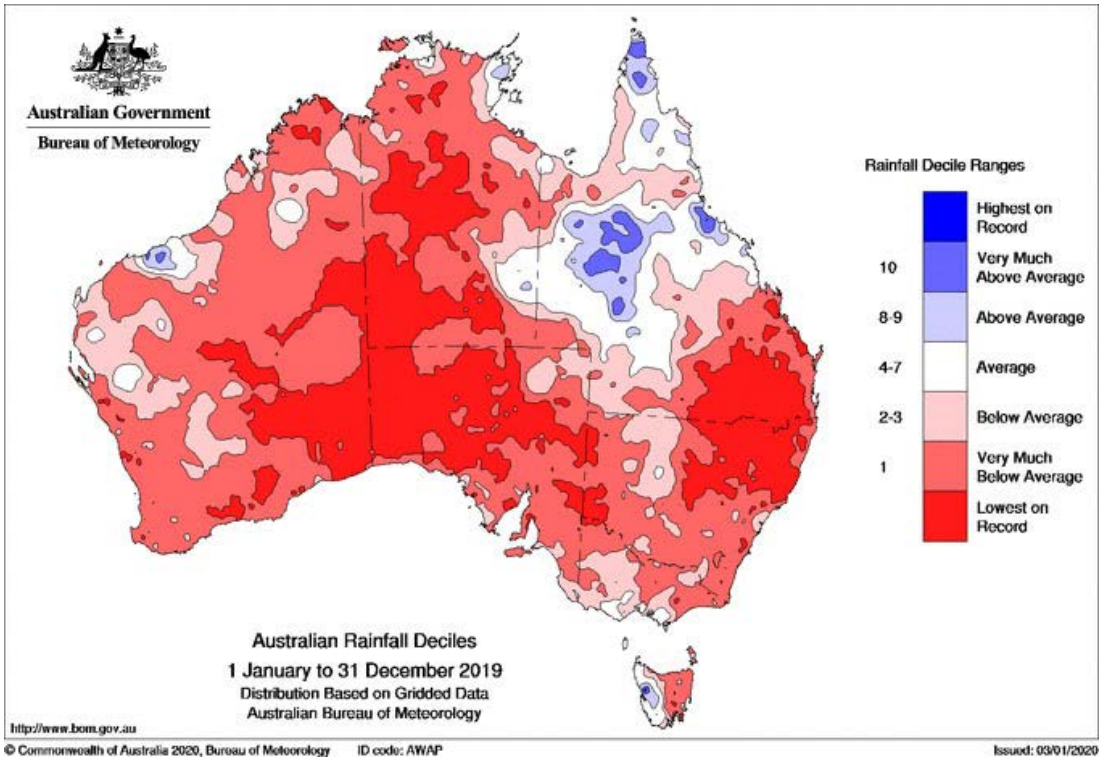

Figure 1.7 - Australian Rainfall Decile Map – 2019 [Source : Australian Bureau of Meteorology - 30/1/2020]

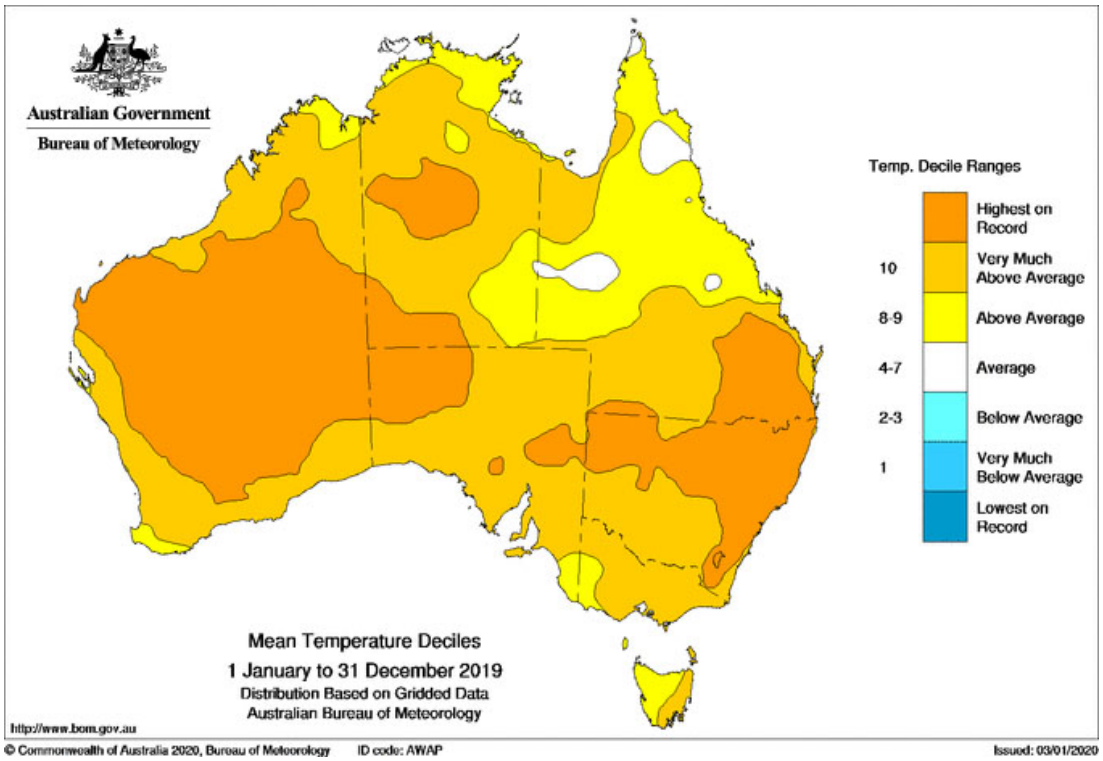

Figure 1.8 - Australian Mean Temperature Decile Map – 2019 [Source : Australian Bureau of Meteorology - 30/1/2020]

1.7.1 The Urban Heat Island Effect

This phenomenon is caused by the prevalence in cities of heat absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air and a general lack of shade and green space. Increases in urban temperatures can increase air pollution, green house gas emissions and substantially reduce human comfort. Temperatures in cities can be up to 4ºC warmer than surrounding suburbs and in the evenings they can be up to 12ºC hotter. This can have dire consequences for the most vulnerable in our communities such as the elderly, lower socio-economic groups and the young.

A recent City of Melbourne report concluded that "the total economic cost to the community due to hot weather is estimated to be $1.8 billion in present value terms." If we don't substantially change the way we manage the growth of our cities, a Flinders University study found that a 1ºC increase in temperature can boost cooling loads by 1.5 million kWh per year, generating an additional 1000 tonnes of carbon dioxide emissions.

1.7.2 Emissions Reduction and Net Zero Carbon Targets

Green infrastructure must be strategical applied to enhance biological and ecological functions at a range of scales. When designed and applied properly, it should help regulate flows of water, energy and materials that maintain urban ecological functions with a definite view to progressing towards carbon neutrality.

Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO^2) and other greenhouse gas emissions occur in the coming decades. Limiting human-induced global warming to a specific level requires limiting cumulative CO^2 emissions, reaching at least 'net zero' CO^2 emissions targets, along with strong reductions in other greenhouse gas emissions (IPCC, 2021).

Many global policies and targets are now striving to achieve carbon neutrality worldwide. For example, the Paris Agreement sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. It has strongly outlined a target of net zero carbon emissions by 2050. Although changes in energy and emissions are key, the uptake of carbon is also a vital component. 'Climate Positive Design Pathfinder', a platform founded by Landscape Architect Pamela Conrad, backed by an extensive list of reputable Universities, Councils, Institutes, designers and many more, has challenged urban developments

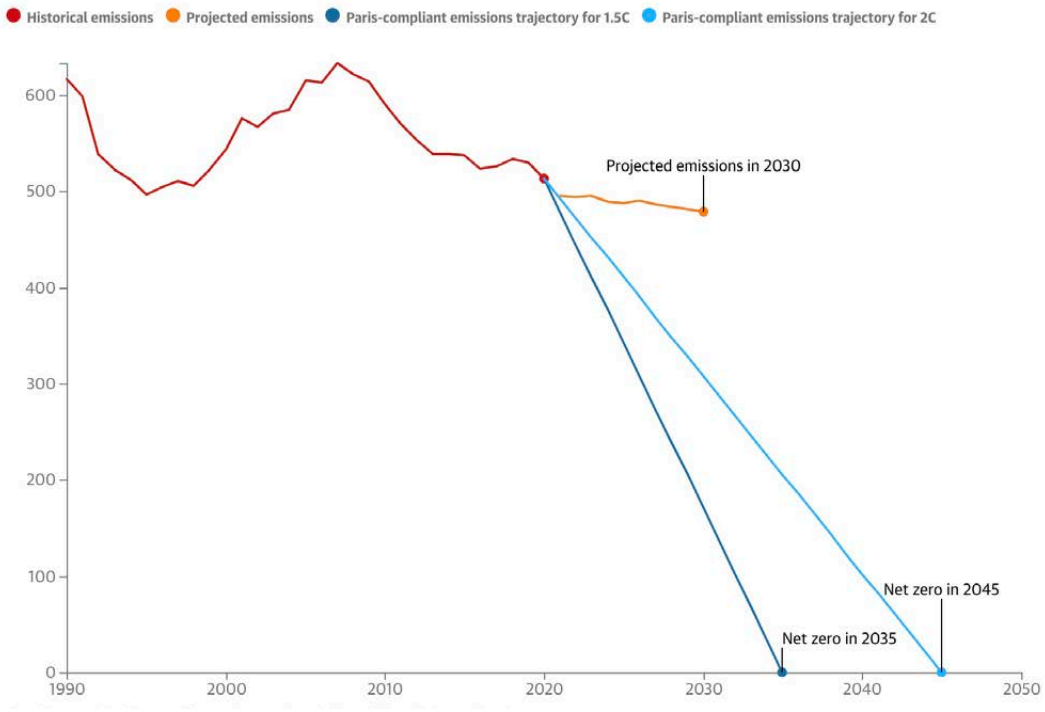

Figure 1.9 - Graph depicting the high carbon emissions in Australia and the urgency of initiating carbon reduction techniques to meet net zero by 2050. This graph draws on statistics taken from the Climate Targets Panel, Australian Emissions Projections, Australian Government Department of Industry, Science, Energy and Resources. [Source: The Guardian, 2021]

to strive to become 'climate positive'. The key to this is using construction materials and processes that inherently emit less CO^2 and the significant planting of new trees and other plants to absorb and sequester CO^2. For example one large tree can sequester 2351kg of CO^2 in its life (taking up on average 98kg annually). If all new projects are designed to meet such specific targets at their core, then over their forseeable life they could potentially sequester more CO^2 than they cause to be emitted via their construction. Measured over a given period, and taking into account a projects 'green infrastructure' contribution to CO^2 sequestration, it is possible to aspire to a 'positive' or a 'carbon negative' emission outcome. If this is more widely achieved, such projects, have the potential to sequester one gigaton of CO^2 by 2050, and when combined with other emission reductions, significantly further our cause towards a carbon neutral future.

Figure 1.10 - The almost unprecedented dust storm that enveloped Sydney in September 2009 (Photo: Arterra)

1.8 Why Are Trees and Green Infrastructure So Important?

Green Infrastructure is a term currently used to define strategically based and planned networks of natural and semi-natural areas, including parks, rivers, bushland and private gardens in urban and rural settings to provide environmental, social and economic benefits to society. Green infrastructure consists of all trees and vegetation located within a defined urban area, irrespective of the species, origin (native, exotic), location (street, park, garden, school) or ownership (public, private, institutional).

Green infrastructure should be envisioned as a three-dimensional envelope that surrounds and connects buildings, streets and utilities. It is a city's natural life support system, and essential for all its functions. There is growing realisation, backed by a very rapidly increasing body of research, that green infrastructure sustains and enhances human health and well-being. We need to be proactive in sustaining our City's existing natural assets or we risk losing them all together.

1.8.1 General Benefits of Trees and the Urban Forest

The 'urban forest' is a key component of our green infrastructure and does much of the heavy lifting, along with other elements like green roofs, in achieving the multiple benefits urban greening can produce. The urban forest is often most easily measured as a canopy cover percentage of the total land area (LGA NSW 2003). It is also one vital component of a complex built environment that includes our roads, car parks, footpaths, underground services, buildings and other urban structures (North Sydney 2011).

Figure 1.11 – Trees are good for our urban areas. Trees provide the most significant and tangible contribution to an urban area's ecosystem services and the comfort and enjoyment of the public realm. A well planned street with excellent tree cover promotes walking and social interaction and contributes to many psychological and social benefits. (Photo: Arterra)

Any green infrastructure strategy needs to align with an ecosystem management approach to provide ecosystem services that can be measured, evaluated and deployed at a landscape scale, transcending traditional private and public land boundaries and geographic and municipal boundaries. At its base is the provision of sustainable and resilient urban systems and places. Green infrastructure is not just individual elements such as a tree, park, garden or wetland, rather it is the entire system of greenery that also interacts with a variety of other built urban systems.

In practice, green infrastructure incorporates and encompasses all vegetation within our wider streets, parks, wetlands, balconies, facades and roofs. This document addresses the urban forest and greening as a whole, but due to the highly urbanised nature of the Sub-precinct has a strong focus on addressing the existing and proposed urban canopy and tree planting. The other vegetation such as roof gardens, lawns, shrubs, ground covers, and 'rain garden' style planting are addressed within this study but there are also other numerous technical studies being prepared for the Sub-Precinct, such as the urban and public domain design documents, ecological studies and overall sustainability reports that must also be referenced and considered in concert with this study.

Trees within urban areas are a major and visible component of the natural resources upon which we rely. They provide a substantial contribution to the 'sense of place', and character of an area. They can have historical significance and provide numerous environmental and psychological benefits to visitors, workers and residents. They can also provide important way-finding and 'landmark' statements. Trees of civic scale or with distinctive forms can be important markers in the landscape and help to demarcate the entry or gateways to an area or help to define important areas, improving way-finding and urban legibility.

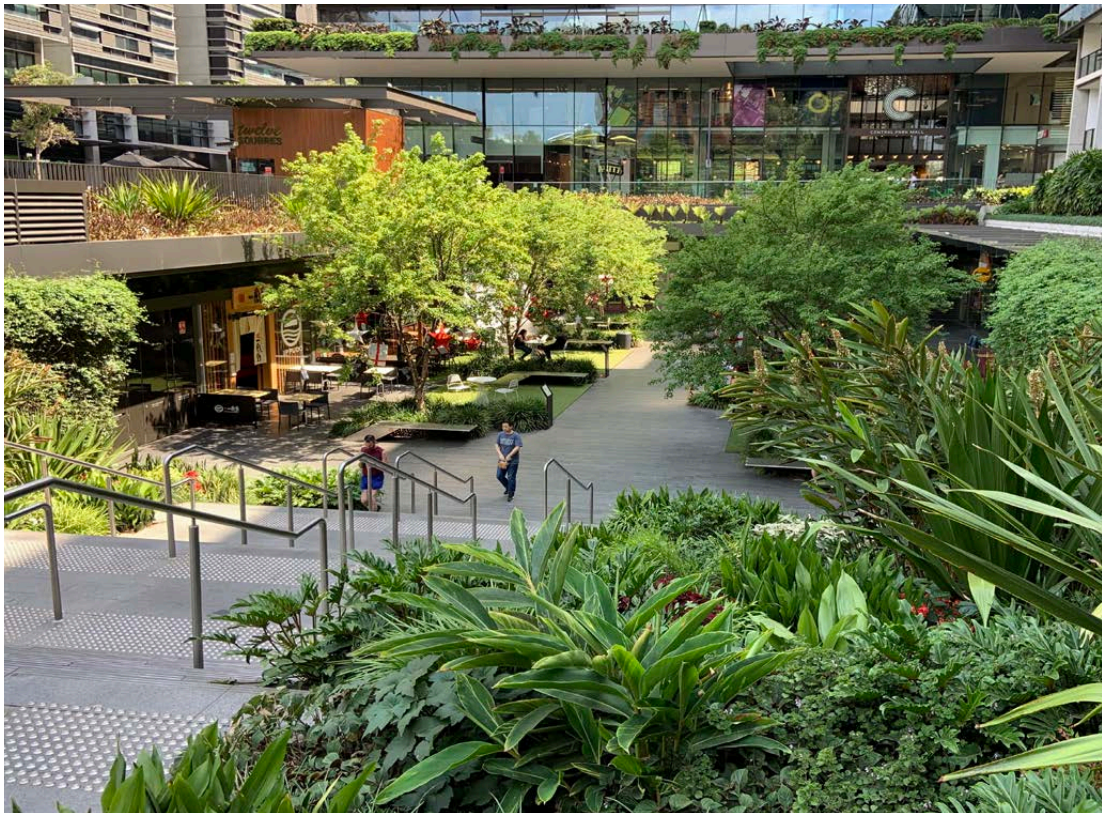

Figure 1.12 – Green infrastructure is a valuable addition to high density urban areas for many reasons. Research has consistently shown that people will be attracted towards, linger longer and spend more money in attractive, greener areas compared to barren or poorly planted areas. (Photo: Arterra)

Examples of the benefits of trees and urban greening, both direct and indirect, include:

- reducing the urban heat island effect and moderation of other weather extremes and winds
- providing cooling and shading to pedestrians and buildings
- lowering energy use (due to the above)
- increasing longevity of pavements and road surfaces due to shading
- shading of parked cars and reduction in hydrocarbon emissions
- storage of carbon dioxide
- interception and storage of rainwater and stormwater via leaves and roots
- filtering of particulate matter and polluting gases
- ameliorating wind
- production of atmospheric oxygen and uptake of carbon dioxide
- provision of habitat for native fauna, birds and insects
- general human health, calming and wellbeing

Few things can compare with the visual impact and seasonal interest trees provide. They foster community cohesion, creating a sense of place and local landmarks. Very importantly, trees can have surprising and profound effects on the psychological wellbeing of nearby residents, particularly in urban areas (Ferrini et al, 2017).

Trees remain one of the most cost effective measures of drawing excess CO^2 from the atmosphere. They also improve air quality by removing and storing a surprising amount of harmful pollutants such as sulfur dioxide, nitrogen oxides, particulates, and heavy metals such as cadmium, nickel and lead.

Trees have also been shown to provide direct economic benefits to a region. The attractiveness of an environment is an important factor in attracting inward investment. Values of properties in tree-lined areas may be up to 6% greater than in similar areas without trees (Wolf, 1998). Rental rates are up to 7% higher for commercial office properties having a quality landscape. Furthermore, consumers report being willing to spend up to 12% more in commercial districts having large trees (Wolf 2009).

Trees also have costs associated with planting and maintaining them and many challenges involved in growing healthy trees in otherwise complex and often unnatural, urban environments. Although the urban forest can most definitely be considered an asset, if not properly planned, cared for and managed, it can also become a liability.

1.8.2 Trees and Human Health And Wellbeing

In 1950, 749 million people lived in urban areas, by 2014 there were 3.9 billion. By 2050 it is forecast that 75 per cent of the world's population will be living in urban areas, which means there will be over 9 billion people living in the world's cities. Australia has one of the highest urbanised populations in the world, with around 90 per cent already living in cities and large towns and it's increasing. Higher density living comes with many challenges and impacts on our health and well-being.

Figure 1.13 – Tree lined street offering extensive urban canopy over Ashmore Street in Erskinville, Sydney (Photo: Arterra)

There is no greater good that can be done for health promotion than the protection and enhancement of greenery on which all humans depend (Coutts, C. and Hahn M. 2015). This is especially for mental health. As outlined by the World Health Organisation, "good mental health enables people to realise their potential, cope with the normal stresses of life, work productively and contribute to their communities". Simply being in, nearby, or with a view of green spaces may help build mental health capacity, contribute to our ability to restore depleted cognitive capacities, enhance recovery from stress and increase our optimism. We also prefer to seek out greenery that has a higher density of tree canopy cover rather than simple spaces such as large grassed areas. (Astell-Burt, T., 2019)

The World Health Organisation calls 'stress' the health epidemic of the twenty first century. Mental ill health and suicide are costing Australia up to $180 billion a year (the Productivity Commission found in October 2019). Anxiety and depression are estimated to cost the European Union €170 billion a year and in the USA over $210 billion.

Finding a way to manage this is critical to our health and wellbeing and trees and other greenery can help immensely. A 2019 Australian longitudinal study titled 'Association of Urban Green Space with Mental Health and General Health Among Adults in Australia' by Prof Astell-Burt and Dr Feng found that urban communities with a healthy amount of tree cover - not just grass and green space - were psychologically healthier than those that didn't.

In neighbourhoods with a tree canopy of 30 per cent or more, adults had 31 per cent lower odds of developing psychological distress, and 33 per cent lower odds of rating their general health as fair or poor over six years. Urban green spaces with open grass rather than a tree canopy did not deliver the same benefits. This research, which focused on Sydney, Newcastle and Wollongong, helps provide a solid target to work towards to provide the community with tangible psychologically health outcomes.

Importantly, there are many other health benefits associated with greenery, such as reductions in cardio vascular disease, skin cancer rates, and 22 per cent lower odds of insufficient sleep.

Greening also has massive benefits for our urban areas connectivity and walkability. Walking and cycling are important benchmarks for a liveable city. High levels of walking mean a city is safe, vibrant and easily accessible by everyone.

Another pressing challenge is urban air quality. In most cities, the most damaging air pollutant is particulate matter. Fine particulate matter (less than 2.5 micrograms in diameter) can be deeply inhaled into the lungs and is estimated to cause 3.2 million deaths per year primarily from strokes and heart disease. It also contributes to chronic and acute respiratory diseases, including asthma. One study forecasts that by 2050, fine particulate matter could kill 6.2 million people per year world-wide. (The Nature Conservancy, 2016).

Trees and urban greening therefore play an important role in making our air healthier, too. Dozens of studies now show that tree leaves filter out particulate matter from the atmosphere, along with absorbing many other air pollutants. Air pollution has been found to be often worsened by excessive heat, which in turn, causes increased chemical reactions to occur with other volatile organic compounds. Ground level ozone concentrations are found to radically increase as ambient temperatures increase. Finally, quality shade provision can also reduce exposure to damaging ultra violet light (UV) by up to 75 per cent. This can be provided by built structures or trees, but trees also produce numerous other benefits.

Figure 1.14 - Trees bring many important benefits, as well as beauty and delight. They can also play an important part of place making and community engagement, being the focus or framework for art installations and lighting displays. (Photo: Arterra)

1.8.3 Trees and Urban Heat Mitigation

Heatwaves are now Australia's deadliest natural hazard. They now arrive earlier, are hotter, and last longer. Urban temperature extremes can present us with life-or-death situations. When temperatures exceed 25°C there is a reported increase in mortality and strokes. In Sydney, the heatwave of February 2011 resulted in 595 people needing treatment in hospital emergency departments, and killed 96 people. In 2009, the Black Saturday bushfires killed 173 people, but the heatwave at this same time killed 374 people in Melbourne alone.

Urban heat mitigation through greening can significantly reduce human heat related morbidity and mortality, and can result in substantially decreased demand for energy due to reduced air conditioning use as well as lower water consumption. (Low Carbon Living, 2017)

In addressing extreme heat, numerous research studies outline the benefits that trees and canopy cover provide. These affects have been measured at the individual street level and on a precinct scale. When addressing the impacts of urban heat, research confirms we need canopy at both the local and precinct scale **- ideally with a minimum of 30 per cent canopy cover.**

Increased urban greening is now a mainstream technique to mitigate urban heat. Urban greening facilitates the cooling of our homes and streets and parklands via evapotranspiration, shading and providing cooler surfaces to reduce the mean radiant temperature.

Canopy trees help to cool any hot air and hot surfaces around them, through shading and evaporative cooling. Individual trees can make a valuable difference to air temperatures at the scale of individual properties, but recent studies have shown that larger groupings of trees, that combine to provide >40% canopy cover, at the scale of a city block can reduce local ambient air temperature by more than 1.3ºC (Ziter, C. et al 2019). Reducing paved surfaces at the same time also helps to reduce heat that is absorbed and radiated back into the air. Therefore extreme heat is moderated most effectively where there is both more tree canopy cover and less hard paved surfaces.

1.9 The Key Objectives for the Urban Forest and Green Infrastructure

The purpose of the this Urban Forest and Greening Study is to provide the **strategic directions and guidelines** for the retention, enhancement, development and management of resilient, healthy and diverse green infrastructure associated with this Sub-Precinct. The urban forest and greening can provide significant environmental, social, aesthetic and economic benefits and contribute to the health and well being of Redfern North Eveleigh, its residents as well as the broader community of Sydney.

The focus is to protect the existing trees and canopy cover, where it exists and is appropriate. Trees and the wider urban forest make a significant contribution to the over arching objectives of creating a sustainable and liveable community. Trees, along with other greening strategies, directly contribute to the achievement of many other critical outcomes such as biodiversity, wind amelioration, shading and urban heat island reduction, stormwater and pollution uptake and amelioration, reduced energy consumption, improved pavement life expectancy, and improved social cohesion and resident well-being. In recent years there has been an explosion of local and international examples driving the work in urban forestry and green infrastructure, but the main bodies of work specifically driving the key objectives for the North Eveleigh Precinct are the:

- CoS -Greening Sydney Strategy 2021 (Draft)
- CoS -Urban Forest Strategy 2013
- Clean Air and Urban Landscapes Hub - Cities for People ad Nature (2020)
- NSW Government Architects Office –(Draft) Greener Places (Oct 2017)

The **key principles** for the 'greening' of the Paint Shop Sub-Precinct are to:

- Implement green infrastructure that is resilient, healthy and diverse and that is recognised and valued for its environmental, social, aesthetic and economic benefits and for its contribution to the health and well-being of the existing and future community.
- Provide an integrated and systematic long-term strategy that values green infrastructure (with trees as a critical component) with equal priority to other infrastructure such as roads and services, while minimising

any potential negative or longer term costs associated with greening in an urban environment.
- Retain and protect the existing trees and canopy.
- Educate the community and future developers and actively promote the benefits of green infrastructure and the urban forest.
- Make appropriate and targeted provisions for the future tree planting and other urban greening initiatives via thoughtful and best-practice design of the streetscapes, public open spaces and new buildings and promote significant, relevant and sustainable natural landscape elements at both the human and civic scales.

This study begins with the detailed assessment of the existing urban forest and the details of the Paint Shop Sub-Precinct. The assessment provides insights as to the current composition, conditions, opportunities and constraints posed by the existing urban forest and the current urban landscape. The remaining sections of the study aims to address the targeted enhancement and improvement of the urban forest. This includes listening to, and embracing our indigenous culture's '**connecting with country**' ethos and meaningfully increasing the urban green infrastructure; particularly through quality and sustainable **tree planting** and significant adoption of **green roofs**.

The following outlines the key initiatives proposed to be adopted for this project, at both the planning level and later at implementation:

- **Retain and protect** the few important and existing trees on the site such as those close to the CMEO building and along Wilson Street.
- **Remove weed** species and undesirable plants to remove potential ongoing weed sources and urban maintenance burdens.
- Expand and enhance the urban forest and **canopy coverage** while respecting the need to maintain the industrial heritage and important views to heritage buildings.
- **Improve biodiversity** by reinstating some key species from the endangered ecological communities that would have once graced the site such as the Turpentine Iron Bark Forest and Eastern Suburbs Banksia Scrub
- Utilise a mixture of species of trees shrubs and ground covers to provide **diversity** of sizes and habitat and address specific urban design outcomes such as dense summer shade, winter sun, wind mitigation appropriate scale and heights to address the future built forms.
- Utilise vegetation, and particularly trees, due to their longer life spans, that can tolerate and prosper in the forecast **warmer climate** of Sydney, in 50 to 100 years time.
- Incorporate vegetation that has meaning and **significance to indigenous** cultures.
- **Mitigate urban heat** affects through increased canopy cover and increased overall greening via the active promotion of 'greening' at the ground level and on roof tops and building podiums.
- Promote and encourage **precinct scale and integrated approaches to water management**, particularly focussed on passive irrigation and collection of rainwater, and potentially grey water, for long term irrigation and sustenance of green infrastructure.
- Create **shaded walkways and streets** that promote active recreation and transport and minimise urban heat absorption and re-radiation.

1.10 Relationship to Other Studies

This study draws upon the input and expertise of several other key studies that have a large bearing on the ultimate Urban Forest and Greening outcomes being proposed. The primary studies of relevance are:

- Public Domain, Place and Urban Design RNE Masterplan by Bates Smart and Turf Studio (2022)
- Environmental Sustainability Report by Arup (2022)
- Connecting With Country Framework Report By Balarinji Studio (2022)
- Aboriginal Heritage Interpretation Strategy - Consultation Summary Report By Balarinji Studio (2022)
- Aboriginal Heritage Interpretation Strategy Report By Artefact Heritage Services Pty Ltd (2022)
- The Ecology and Biodiversity Report by WSP (2022)
- Utilities and Servicing Strategy Report by AECOM (2022)

A brief summary of these and the key insights that have been drawn during the preparation of the Urban Forest and Greening Study is included in the following pages.

The Public Domain, Place and Urban Design [Bates Smart & Turf Studio]

The proposed master plan option has been refined with improvements resulting from a collaborative and cross disciplinary coordination with the client and design team as well as reviews from a number of workshops including the DRP, DPE, CoS and a series of specialist technical advisory groups, internal and external to Transport. There is very strong emphasis on creating high quality places, providing excellent amenity, and being responsive to the existing qualities of a neighbourhood. The recurrent emphasis on the importance of landscape and ambitious greening targets are important considerations. The Connecting with Country policy also challenges the prevailing 'peoplecentric' paradigm and invites a different way of considering landscape, connection to place, memory, and culture. This suggests both different ways of approaching design and different outcomes.

Some initiatives and considerations in the current proposal are:

- The Paint Shop Sub-Precinct is part of and connected to a large and exposed 20 hectare railway corridor area to the south that generates urban heat.
- Reducing urban heat requires a suite of solutions including green cover, urban tree canopy shade, swales, rain gardens and changes to building and landscape materials and colours.
- As a previous industrial site there are few existing shade trees, and an increase will be essential. Shade assists with the reduction of reflected and re-radiated urban heat.
- Increasing urban heat can be mitigated through green cover in urban spaces and on building roofs, terraces and wall surfaces. It aims to meet or approach the policies and targets established by NSW Government Architects 'Greener Places' and City of Sydney's 2021 'Greening Sydney Strategy', as much as possible given other site and urban design constraints.
- Articulating water through public spaces for cooling, noise mitigation and aesthetic purposes. Large volumes of roof and surface water generated are to be managed and used on site. There are potentials for stormwater detention, mitigation and irrigation opportunities.
- Providing soil depth that provides optimum growing conditions for gardens and trees.
- Maintaining a level of permeability and on–site detention that reduces downstream flooding and waterway pollution whilst retaining moisture on the site for trees and other plant growth.
- The creation of a Paint Shop Square with direct pedestrian access from Wilson Street to provide a new social and urban hub to promote outdoor gatherings that will accommodate break out spaces and a pavilion structure.
- An eastern park with direct access from Redfern Station and Little Eveleigh Street, which will provide a high amenity public space by ensuring good sunlight access and comfortable wind conditions.
- The establishment of an east-west pedestrian thoroughfare with new public domain and pedestrian links with a range of Water Sensitive Urban Design (WSUD) features.
- Active ground level facilities with commercial, retail, food and beverage and community and cultural uses.
- Adaptive reuse of the heritage buildings for employment, cultural and community uses.
- Commercial buildings along the rail corridor that range between 13 and 22 storeys.
- Mixed use buildings along the rail corridor, comprising a three-storey non-residential podium with residential towers ranging between 18 to 28 storeys.
- Commercial and residential buildings along Wilson Street with a five-storey street wall and upper levels at 8 storeys that are set back further from the street.

The East-West Green Link Response - Approximately 3800 square metres in area, the east–west spine establishes a comfortable and legible urban streetscape. This street spine provides a human scaled corridor that provides high amenity for pedestrians along a weather protected route with active frontages, outdoor dining, on street parking, street trees and smaller public spaces and laneways and links off the spine allowing north-south connections. Its key features:

- A primary public link between station, buildings, public spaces, Paint Shop and Carriageworks.
- Provides vehicle and emergency access to buildings, drop off, loading and parking.
- Legible north facing sunny street with activities, entrances, retail and dining.
- Provides greening, shade and integrated WSUD stormwater management opportunities.
- A public place for local community and the on site community that feels a part of the city.
- A shared street space where pedestrians and bicycles are the dominant transport modes.
- Appropriate scale refelective of other streets in Darlington, Redfern and Chippendale neighbourhoods with weather protection and active facades to walk by.
- Internal activities visible to three floors above street.

The Environmental Sustainability Report [Arup]

In consideration of the Sub-Precinct's early development stage, this report outlines potential scenarios that would achieve the desired sustainability outcomes through a number of different design, technology, construction, or management initiatives throughout the Precinct's next development stages. A number of initiatives have already been integrated as part of this proposal. Where initiatives require a greater level of design resolution and certainty about the Precinct's future governance and ownership structures, these have been noted as options for future consideration.

It recommends performance benchmarks and design guidelines, in line with current best practice industry standards. These benchmarks and guidelines exceed the previous Concept Plan approval from 2008 and in summary commit to formal future certification under the following sustainability rating schemes and performance outcomes:

- Green Star Communities – 5 Star rating.
- Green Star Buildings – 5 Star rating.
- BASIX targets – exceed by 10 per percent.
- NABERS Energy – 5.5 Star rating.
- NABERS Water – 4 Star rating.

The overarching sustainability driver for the Sub-Precinct is that the development must undertake activities that are in the interest of the greater good, moving beyond compliance, and being a genuine leader in environment and sustainability performance (Source: NSW Government Transport Environment and Sustainability policy, 2020). To achieve this, associated principles for the Sub-Precinct have been defined in the context of four sustainability themes, which enable a number of desired sustainability outcomes.

- Maximise energy efficiency and minimise green house gas emissions.
- A water positive precinct, with water at the heart of design.
- Maximise resource efficiency and recovery at the precinct scale.
- A precinct that is resilient to extreme weathers and resource constraints.

These initiatives and their more direct relationship to the Urban Forest and Greening Study are detailed below.
Water - Ensure that both individual development sites and the Precinct incorporate best practice sustainability and environmental performance measures relating to water. This includes supporting the following objectives:

- Delivering an integrated water cycle management strategy.
- Reducing the use of potable water.
- Encourage sustainable water use practices.
- Optimising water efficiency and productivity across the Precinct and seek alternative water supply sources where appropriate.
- Integration of green spaces and WSUD into the Precinct.
- Best practice stormwater management, targeting 100% capture, harvesting, and reuse.
- Public space irrigation to be achieved with non-potable water.

Reference should also be made to further detail analysis in the Arup Report and their opportunities and recommendations regarding total integrated water cycle management.

Future Design Strategies - At the Development Application stage it is anticipated the Sub-Precinct will develop a more specific integrated water cycle management strategy to ensure an optimised sustainable water solution for the precinct and buildings. The initiatives expected at this time are:

- The current proposal does not preclude future scenarios where a decentralised water utility may operate.
- Ensure water and green infrastructure are in close connection with each other.
- Integrate any appropriate recommendations from the The Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (2006).
- Ensure water discharged from a private building stormwater system is first used to supply the landscape of the public domain ahead of immediate discharge to offsite drainage system.
- Extensively collect and re-use stormwater run-off in the public realm to irrigate and sustain green infrastructure.
- Design urban water systems and streetscapes that focus on passive systems that allow for irrigation through direct rainfall and natural water flows.
- Use locally appropriate planting that is suited to environmental conditions and are drought resistant.
- Separate meters are to be installed for each individual tenancy in commercial or retail buildings over 5,000 square metres, such as separate tenant areas within a shopping centre.

- Separate meters are to be installed for the make-up lines to cooling towers, swimming pools, on the water supply to outdoor irrigation, and other major uses.

Climate Change - Ensure that both individual development sites and the Sub-Precinct as a whole incorporate best practice sustainability and environmental performance measures relating to climate change and microclimate. This includes supporting the following objectives:

- Incorporating measures to address the impact of climate change including urban heat and extreme weather events.
- Reduce the cause and impacts of the urban heat island effect.
- Increase the resilience of development to the effects of climate change.

Connecting With Country Framework Report [Balarinji Studio]

This report identifies a place with a *"unique combination of cultural, built, and historic factors that distinguishes the Redfern North Eveleigh Precinct from other places and forms the foundation of its identity.*" This unique precinct is located on Gadigal Country on one of the most significant sites of contemporary Aboriginal Australia.

A central pillar of Aboriginal culture is a collective responsibility for sustaining Country for generations to come. Caring for, and sustaining Country involves a complex biodiverse system that has been managed for tens of thousands of years within cultural rules and protocols. Country is more than nature, it is Dreaming, an all-embracing concept from the Aboriginal worldview which has no European equivalent. Regeneration is at its heart.

Some key elements outlined in the above study are:

- Integrate native flora and fauna in the Redfern North Eveleigh Precinct. When the stakeholders were asked about what flora and fauna were important to the Redfern North Eveleigh Precinct their response was not about singular plants or animals. Instead, they described functional ecosystems and cultural landscapes. The discussion was focused on the opportunity to restore Country and recreate pockets of these lost ecosystems. Gadigal horticulturalist Adam Byrne said: "It's about giving back to that land and mirroring what was there... rehabilitate the land."
- Commit to the best practice of a cultural co-design process with the locally connected Aboriginal community whereby stories of Country are deeply embedded in the Precinct. *"Country Listens, County Heals and Country Knows. Need to explain this to people. Country is ever-present – Country owns us, we don't own the Country. Country is living. You must protect her and look after her. This needs to underpin this piece of work."* – Binowee Bayles. When they spoke to the stakeholders about the key things they would want to communicate about Country, the recurring themes were:
    - The importance of a holistic view of Country (Sky, Land, Water)
    - The need to regenerate Country
    - The need to speak language and bring language back onto Country
    - The need to acknowledge Country underneath the Concrete.
- Work with community to improve the health of Country. In order to improve the health of Country, there needs to be a holistic approach to the design of the Redfern North Eveleigh Precinct. Clean energy use and sustainability are core to Aboriginal principles of designing with Country. When asked how the health of Country could be improved through this project Gadigal horticulturist Adam Byrne suggested *"Using clean energy, like solar power. Not using chemicals in the landscape or any of the surroundings. Reusing things, reusable materials throughout the area. In the shops – Being conscious about using plastic, food waste etc. Having an agreement with residents in the area to reduce waste and tackle climate change. This links into caring for Country.* Planting native trees will restore the traditional tree canopy. This will help to restore the ecosystem. Gadigal Elder Ray Davison spoke about the need to recreate balance in the Country through reintroducing the waterways: *"Reconnect to Water – the water system is the life-giver and life sustainer. Reintroduce water and the plant life that goes with it."*

Trees and plants can be significant for marking seasonal change, medicinal and food use, fibres and other materials for tools and weaving or containers. Some of the trees specifically mentioned as significant to indigenous community stakeholders during consultation included:

- *Acacia binervia* (Coastal Myall)
- *Acacia implexa* (Hickory Wattle / Wee-tjellan)
- *Acacia falcata*
- *Eucalyptus sp.* generally

- *Ficus rubiginosa* (Port Jackson Fig)
- *Brachychiton populneus* (Kurrajong)
- *Podocarpus elatus* (Plum Pine)
- *Syncarpia glomulifera* (Turpentine)

Some other shrubs and groundcover plants included:

- *Bulbine bulbosa* (Wild Onion)
- *Dianella sp.* (Flax Lilly)
- *Doryanthes excelsa* (Gymea Lily)
- *Themeda australis* (Kangaroo Grass)
- *Lomandra longifolia* (Matt Rush)
- *Austromyrtus dulcim* (Midyim Berry)
- *Rubus parvifolius* (Native Raspberry)
- *Carpobrotus glaucescens* (Pig Face)
- *Apium prostratum* (Sea Parsley)
- *Telopea speciosissima* (Waratah)
- *Tetragonia tetragonioides* (Warrigal Greens)
- *Xanthorrhoea arborea* (Grass Tree)
- *Microseris sp.* (Yam)

A particularly relevant quote regarding the urban forest was put forward during the consultation regarding an endemic tree, the *Ficus rubiginosa* (Port Jackson Fig) termed the 'teaching or grandfather tree'. Cameron Davison provided the following comment - *"... the Port Jackson Fig, Ficus rubiginosa, (damun) which we know as the Grandfather Tree or the Teaching Tree in that its branches, which would reach the ground, would sort of create its own atmosphere of a classroom. And you can even imagine the branches trailed in such a way to create seats for the teacher, and seats for all the students."*

Finally the Connecting With Country report promotes the use and integration of aboriginal-owned land management and horticulture businesses such as organisations like:

- Bush to Bowl
- Jiwah
- Wild Flower Gardens for Good
- Yerrabingin
- Muru Mittigar Native Nursery
- Indigrow
- Seed Mob

Aboriginal Heritage Interpretation Strategy - Consultation Summary Report [Balaringi Studio]

Among numerous other initiatives, the planting and green spaces were emphasised as an important interpretive feature to include in the Sub-Precinct's redevelopment. Indigenous respondents suggested:

- Including native planting with signage to help educate people on the local flora and its traditional uses.
- The need to include green spaces to bring back the feeling of 'bush' in the city.
- Native gardens and green spaces to encourage ongoing participation, interpretation opportunities and engagement.
- Inclusion of local business's engaging in these endeavours.

Aboriginal Heritage Interpretation Strategy Report [Artefact Heritage Services Pty Ltd]

During the last two decades, Redfern and Eveleigh have undergone strategic urban renewal, with Aboriginal-led organisations and sustained, meaningful community consultation leading the way. In 2011, the Aboriginal Housing Company announced its planned redevelopment of The Block into the Pemulwuy Project, a mixed use site including affordable housing for Aboriginal and Torres Strait Islander families, childcare, a gallery and commercial spaces. In 2019, Yerrabingin designed a native rooftop farm at South Eveleigh, featuring over 2000 edible, medicinal and culturally significant plants. Today, the land around the subject site continues to hold a deep significance for the Aboriginal community and is home to many Aboriginal families.

The above document outlines and seeks to:

- Reinforce a sense of belonging for the Aboriginal community through the provision of considered design and cultural spaces, achieved through ongoing engagement with local Aboriginal communities.
- Contribute to the understanding and appreciation of Aboriginal culture through its integration into the precinct, creating a lived experience.
- Embody Designing with Country and Understanding Country principles into design strategies.
- Continue to engage with Aboriginal communities to understand how the significance of Redfern North Eveleigh as a place for Aboriginal people in the past, the present and the future can continue to be brought to life.

The strategy presents a range of opportunities for interpretive media at the Redfern North Eveleigh Precinct. These options have been assessed as appropriate media to provide audiences with a creative, embodied and engaging experience with Aboriginal cultural values and should be developed in consultation with Aboriginal knowledge holders and artists/designers. Identified potential interpretive media relevant to the greening strategy include:

- Integration of Aboriginal heritage expression elements in the built forms .
- Landscape geometry, and plantings.
- Rooftop gardens.
- Naming/use of language .
- Ground plane elements.
- Gathering spaces, seating, yarning circles.
- Shade elements.
- Wall features.
- Lighting and soundscapes.
- Public art.

Planting of species that were in the Sydney area prior to European arrival, and therefore part of the Indigenous landscape experienced by the local Aboriginal community, is also a powerful interpretive feature that can be implemented within public domain areas. The endangered Eastern Suburbs Banksia Scrub ecosystem, thriving in the nearby sandy soil deposits, was the predominant vegetation near this area before European arrival. It comprised heath or scrub with small areas of low forest, including varieties of *Banksia, Melaleucas*, grasses and *Xanthorrhoea*. The Gadigal were named from the native Grass tree (*Xanthorrhoea*), known locally as the Gadi (Cadi) tree. It was used to make sections of spear shafts with the stems and resin and was culturally significant to the Gadigal. Traditionally, the flowers, nectar, fruits and leaf-bases of many plants and shrubs from the Sydney area (including varieties of *Melaleuca, Banksia, Grevillea* and *Hakea*) were collected and processed by Aboriginal people at certain times of the year. Tea tree (*Melaleuca*) bark is recorded to have been used to make containers, while the bark of other trees is also recorded to have been employed in the construction of semi-permanent shelters and/or dwellings. Introduction of species from the Eastern Suburbs Banksia Scrub ecosystem into the Redfern North Eveleigh Precinct landscape, as well as being a key interpretive feature, could provide biodiversity benefits as it is an endangered bio-community. Consideration of planting which reflect the six seasons, as defined by Aboriginal botanical knowledge, should also be considered.

While native planting should be integrated with the public domain spaces, a dedicated rooftop garden growing Aboriginal food and medicinal plants should also be considered. Adjacent to the precinct, the native rooftop farm of 500 square metres at Yerrabingin House in South Eveleigh provides not only an environment full of over 2000 edible, medicinal and culturally significant plants, but also supplies specialist restaurants and shops through an urban food production program and employment for Aboriginal people. Continuing and expanding this project by including rooftop garden spaces within the Paint Shop Sub-Precinct should be considered.

Ecology Assessment Report [WSP]

An ecological assessment for the site was conducted. It concluded that upon undertaking the proposed green cover objectives and planting the study area will ultimately have enhanced ecological value and create fauna habitat well above what is currently present. Some of the relevant findings were that the site has been comprehensively modified from its original state. The natural vegetation has all been cleared and no remnant vegetation was observed. There are some native plants, however, this native vegetation is not naturally occurring and cannot be assigned to a Plant Community Type (PCT) as identified in the DPIE BioNet Vegetation Classification.

The habitat types in the proposal site and wider study area are best described as miscellaneous ecosystems, specifically highly disturbed areas with no, or limited, native vegetation. Although large mature trees exist along the perimeter of the study area, no significant hollow bearing trees were observed during the surveys. The potential of other fauna habitat is considered minor due to the poor habitat quality within the study area and general lack of mid-storey or ground cover habitat. There are no areas of significant vegetation surrounding the study area that are presently forming connectivity from the study area to the wider landscape. The railway corridor is identified as a potential habitat linkage as outlined in the City's Urban Ecology Strategic Action Plan, although extensive fauna habitat is not present within the rail corridor currently.

In terms of habitat, the proposal site is located within a highly disturbed urban landscape where most habitats have been cleared. However, planted urban vegetation, such as the planted street trees, do provide some habitat and plays a role in facilitating the movement of threatened species across the landscape, as stepping-stone elements. Functional connectivity exists for highly mobile fauna species such as birds and bats that use the airspace above the proposal site to move between habitats and the planted vegetation is likely to be used as a foraging or perching resource as part of daily movements.

In terms of threatened species, a very small portion of the Grey-headed Flying-fox population could potentially use the planted Myrtaceous street trees. It is somewhat possible Swift Parrot may move through the area and forage on the planted Myrtaceous street trees, although this is likely to be rare.

The current proposal is considered highly unlikely to have a detrimental effect on fauna habitat connectivity. The threatened species that may use the development site are capable flyers, able to cover large distances between higher quality habitat patches. The habitats in the development site are not important or unique in the landscape and the proposal will have little effect on the current dispersal and movement of species through the locality.

Given the highly modified nature of the study area, the proposed ecology strategy intends to find a balance between potentially competing aims for the site. For this project, the concept of biodiversity creation and value will need to move away from some-what traditional thinking, such as the creation of reserves with locally indigenous flora species, and instead focus on singular elements, such as street trees, garden beds, pocket-parks and planter boxes, to create biodiversity value on a small-scale, which will then combine to create biodiversity across the Precinct as a whole.

Providing additional opportunities for species habitat is important. In urbanised landscapes, all natural areas, regardless of size or composition have existing and potentially enhanced values for wildlife and other biodiversity. Maintaining or creating habitat can include:

- Protecting existing habitat and green spaces, through exclusion fencing or securing land tenure.
- Restoring areas of low ecological value (revegetation).
- Adding habitat treatments, such as artificial nest boxes or logs.
- Adding urban greening design, such as planter boxes, green roofs, walls or facades.
- Retention of both native and non-native planted trees and shrubs.

Generally, the larger the habitat area, the more likely it is to support a more diverse set of species. Nevertheless, small spaces and single elements of habitat (for example a tree hollow, a flowering shrub, a thicket of native grasses) can be extremely valuable and should be protected or created. This concept is particularly relevant to this project, where larger areas of remnant habitat are not present, and as such, cannot be protected and incorporated into the design.

Therefore, the project will instead focus on:

- Appropriate planting of existing green spaces.
- The addition of habitat treatments for priority fauna species.
- The addition of smaller-scale greening design elements, such as green walls or planter boxes.
- The inclusion of logs, rocks and rock piles, undulating grassed areas or small ponds should be incorporated in green space design (pocket parks), which can also add value as children's play areas.

Principles to enhance urban biodiversity and the insights and measures that have been considered throughout the Urban Forest and Greening Strategy and will be included with the Ecological study recommendations:

- Standard fauna salvage protocols for local wildlife during tree removals, such as for birds nesting within the planted mature trees.
- Retention and enhancement of Myrtaceae tree species, including native and non-native species, to support Flying-fox and Swift Parrot intermittently foraging through the study area.
- Further retention or valuation of trees that are classified as 'High' value for Swift Parrot foraging, such as the Sugar Gum along Wilson Street.
- Removal and long-term management of Australian White Ibis nests within Trees 205, 206 and 209, as well as throughout the site where applicable in future.
- Maximised garden space.
- Retention of both native and non-native planted trees and shrubs.
- Appropriate (diversity and species) planting of existing green space.
- The addition of habitat treatments for priority fauna species.
- The addition of smaller-scale greening design elements, such as green walls or planter boxes.
- The inclusion of logs, rocks and rock piles, undulating grassed areas or shallow water trays or small ponds should be incorporated in green space design (pocket parks), which can also add value as children's play areas.
- A diversity of planting for pollinating insects and small birds. The choice of flora species to plant should focus on diversity of flowering and fruiting species, rather than solely on the inclusion of locally indigenous species.
- Mitigation measures for noise and lighting to prevent exclusion of fauna species longer-term. Some larger green space areas should be prioritised for reduced human-use and light at night.

2. THE EXISTING SITUATION AND URBAN FOREST ASSESSMENT

2.1 Relevant Greening and Tree Related Guiding Policies and Strategies

Increasingly the community, higher level government agencies and other key stakeholders are recognising the value and importance of green infrastructure, urban trees and the canopy cover they provide. This includes organisations such as the:

- United Nations.
- NSW State Government, via the Premier's Priorities and numerous other policy documents.
- The Greater Sydney Commission.
- The NSW Government Architect.
- Local Governments.

The proposal and initiatives outlined in this study have been considered in relation to numerous existing Council and other authority policies that seek to influence the future patterns and development of green infrastructure within urban environments. This has included documents such as:

- NSW OEH - Urban Green Cover in NSW 2012 - Technical guidelines
- NSW Government Architects Office -The Green Grid-creating Sydney's open space network
- NSW Government Architects Office –(Draft) Greener Places (Oct 2017)
- CoS -Greening Sydney Strategy 2021 [Draft]
- CoS -Urban Forest Strategy 2013
- Transport for NSW - Cycling Future 2013, Walking Future 2013
- CoS -Streets Code
- CoS -DCP 2012
- CoS -Public Domain Manual
- CoS -Landscape Code 2016
- CoS -Tree Management Policy 2013
- CoS -Street Tree Master Plan 2015
- CoS -Environmental Action 2016-2021 Strategy and Action Plan (Draft endorsed March 2017)

Some other key documents that have also been considered include:

- Clean Air and Urban Landscapes Hub - Cities for People and Nature (2020)
- Low Carbon Living CRC – Guide to Urban Cooling Strategies (July 2017)
- National Green Infrastructure Network-Urban Ecology : Theory Policy and Practice in NSW (May 2017)
- City of Melbourne/Victorian Dept. Environment, Land, Water and Planning – How to grow an urban forest
- The Nature Conservancy Washington – Outside our Doors (2016)
- The Nature Conservancy Washington – Planting Healthy Air (2016)
- Trees and Design Action Group – No trees, no future : trees in the urban realm (Nov 2008)

Figure 2.1 – An example of some of the urban greening canopy cover policies and documents (Source: Various / Arterra)

In addition to the above, numerous local Councils around Australia have already declared a state of 'climate emergency' and recognised that urgent action is required to deal with climate impacts and potential for impacts of urban development on human and well-being in the future. The City of Sydney has joined over 1,000 local governments and jurisdictions worldwide to declare such a climate emergency. The NSW Premier, has listed the greening of our urban environments as a "Premier's Priority". Street trees and tree planting are now increasingly recognised by all levels of government as one of the most crucial areas to address and enhance.

Council's and private entities, across the country, need to radically increase the priority and value placed on achieving quality tree planting and other green infrastructure. There needs to be a very proactive approach to removing unjustified 'road blocks' to achieving essential greening initiatives and importantly to recognise the nexus between 'greening' and 'water' and commit to better utilisation of our urban stormwater and wastewaters for the betterment, resilience and sustainable health of all urban greening.

We are already seeing the impacts of climate change, particularly in our urban areas. Heat records have continued to be broken, with Sydney reaching its highest ever-recorded temperature, and Penrith reaching a staggering 48.9°C during the recent heatwave of 4 January 2020. Sydney had many months with below-average rainfall in 2019, but also some very wet months, but still its annual total rainfall was in the driest 15% of all years.

2.2 Stakeholder and Community Consultation

In keeping with the considerations and consultation outlined in the study requirements, Transport has prepared and undertaken numerous stakeholder consultation meetings and discussions. This is outlined in considerable detail within the Stakeholder and Community Consultation report prepared by Transport.

With regard to 'urban greening', Arterra have been provided, by Transport, with relevant feed back and directions regarding various stakeholder discussions and have incorporated that feedback and advise, wherever possible.

We can also confirm that specific talks and presentations have been made to the relevant internal stakeholders of the CoS, via a meeting on the 5 October 2021. The CoS, subsequent to that meeting, provided written feedback to Transport. Where possible, many of the directions and advice regarding the proposed 'greening' strategies have been applied within the proposal, and due consideration otherwise given to the CoS's feedback.

2.3 Existing Trees - Assessment Methodology

An assessment of all the existing trees was carried out by Arterra, via a visual inspection of the trees within and adjacent the Sub-precinct in May 2019. This assessment was achieved using the expertise of our in-house consulting arborists (AQF Level 5), Robert Smart and (AQF Level 5), Chloe Bristow. Robert Smart is a member of the International Society of Arboriculture - Australian Chapter and also a Registered Consulting Arborist with Arboriculture Australia and a licenced Quantified Tree Risk Assessment practitioner. Robert Smart has 25 years experience in managing trees in complex development sites. Robert is also a Registered Landscape Architect with over 30 years experience.

The trees were photographed and given a unique identification number. The tree locations were based on the provided topographical survey plans and ground-truthing. Most of these surveys dated from circa 2019, so Arterra verified the existence of the trees (some trees had been removed or added since the survey) and plotted them onto accompanying accurate drawings for general referencing, co-ordination and identification.

Tree trunk diameters, tree heights and canopy spreads were estimated in the field and cross-referenced to survey information and current aerial photography. Canopy position and extents have been adjusted, where necessary, on the plans to more accurately portray the canopy extent and positions. Due to difficulty in gaining access to certain areas, some trees were only assessed from a distance, or from one side only. Arterra can, therefore, not guarantee that all significant defects or major issues were assessed and identified with all trees.

We specifically note that the existing trees assessment was undertaken in May 2019. Statistics, and drawings throughout this report that relate to existing trees have not been updated to account for any subsequent tree removals or any additional new planting that may have subsequently occurred. Tree removals due to Sydney Trains operational use, maintenance, tree failures and changes of tree condition post 2019 are therefore not accounted within these statistics. No large scale changes are expected, or understood to have occurred, and therefore the broad information contained in this study remains valid and relevant for planning assessments.

Detailed and updated tree assessments and topographical surveys would naturally be expected to occur with all future detailed designs and development applications.

2.4 Tree Retention Values of Existing Trees

The retention value of existing trees throughout the study area was assessed using a combination of techniques commonly used and recognised in the arboricultural industry. All the trees have then been given one of the following retention values:

- High
- Moderate
- Low
- Very Low / Remove

The location of the trees and their relative retention values was plotted on to survey drawings. Refer to Figure 2.40 for a graphical representation of the trees and their retention value for the Redfern North Eveleigh Paint Shop Sub-Precinct. Explanation of the criteria used to determine the 'Tree Retention Values' and examples of the trees are summarised in the following pages.

"High" Retention Value – these are trees that are typically large and visually prominent, historically or environmentally important, in good or very good condition. They may also be part of an important group of trees. They should represent a serious physical constraint to the development and their removal avoided where possible and feasible. The following figure illustrate an example of 'high' value trees.

Figure 2.2 – Example of a significant 'High' value tree (Cinnamomum camphora) a Camphor Laurel (T208) adjacent to The Chief Mechanical Engineers Office building within Redfern North Eveleigh Paint Shop Sub-precinct. (Photo: Arterra)

Figure 2.3 – Example of a significant 'High' value tree (Platanus x acerifolia) a London Plane Tree (T49) along Wilson Street. (Photo: Arterra)

Figure 2.4 – Example of a significant 'High' value tree (Eucalyptus microcorys) a Tallowood (T204) adjacent to The Chief Mechanical Engineers Office. (Photo: Arterra)

Figure 2.5 – Example of a significant 'High' value tree (Phoenix canariensis) a Canary Island Date Palm (T209) adjacent to The Chief Mechanical Engineers Office. (Photo: Arterra)

"Moderate" Retention Value – these are trees that are in good to reasonable condition and should be retained where possible and feasible to do so. They may also be lesser trees, but part of a relatively good grouping of trees and therefore warrant retention based on the overall group's value.

The trees ranked as moderate as part of this assessment covered a broad range of trees and tree forms. Most were mature trees with average forms and vigour or some minor defects. Many were also smaller trees or semi-mature trees with very good forms, vigour and future potential to actively contribute to the urban forest, as shown in the examples below.

Figure 2.6 – Example of a 'Moderate' value tree (Lophostemon confertus – Brushbox (T07) on Wilson St (Photo: Arterra)

Figure 2.7 – Example of a 'Moderate' value tree (Platanus x acerifolia – London Plane Tree (T01) on Wilson St (Photo: Arterra)

Figure 2.8 – Example of a 'Moderate' value tree (Eucalyptus saligna – Sydney Blue Gum (T21) on Wilson St (Photo: Arterra)

Figure 2.9 – Example of a 'Moderate' value tree (Eucalyptus botryoides – Bangalay (T28) on Wilson St (Photo: Arterra)

"Low" Retention Value – these are trees that are of poor condition or have structural defects, are particularly small growing or commonplace trees, are not historically, environmentally or socially significant and should not be considered as a constraint to the future development. They could be retained, but only if they are not likely to be impacted by, or constrain potentially desirable, development outcomes.

The trees ranked as low as part of this assessment were either considered young and replaceable, or were suppressed due to their close proximity of other trees or were in poor or declining condition, as shown in the examples below.

Figure 2.10 – Example of a 'Low' value tree (Sapium sebiferum) – Chinese Tallow Tree in relatively poor condition and position (T247) (Photo: Arterra)

Figure 2.11 – Example of a 'Low' value tree - small, over-mature and poorly formed Melaleuca bracteata's - (T214,215) that are not endemic and do not contribute greatly to the urban forest (Photo: Arterra)

Figure 2.12 – Example of a 'Low' value tree (Callistemon viminalis) – Bottlebrush (T234), which relatively small and with structural defects (Photo: Arterra)

Figure 2.13 – Example of a 'Low' value tree (Eriobotrya japonica) – Loquat (T251), which relatively small and a somewhat undesirable species (Photo: Arterra)

Very Low / No Retention Value – these are trees that are in very poor health, or poor form, or have serious structural defects, are considered weeds or a combination of these, and therefore should be considered for removal regardless of any future development.

Figure 2.14 – Example of a 'Very Low' value tree - a very poorly formed Agonis flexuosa – Willow Myrtle (T58) along Wilson Street. (Photo: Arterra)

Figure 2.15 – Example of a 'Very Low' value tree - one of the many self-sown Celtis sinensis – Chinese Hackberry (T232) growing within the Precinct, many are in very inappropriate locations, are invasive and should be removed. (Photo: Arterra)

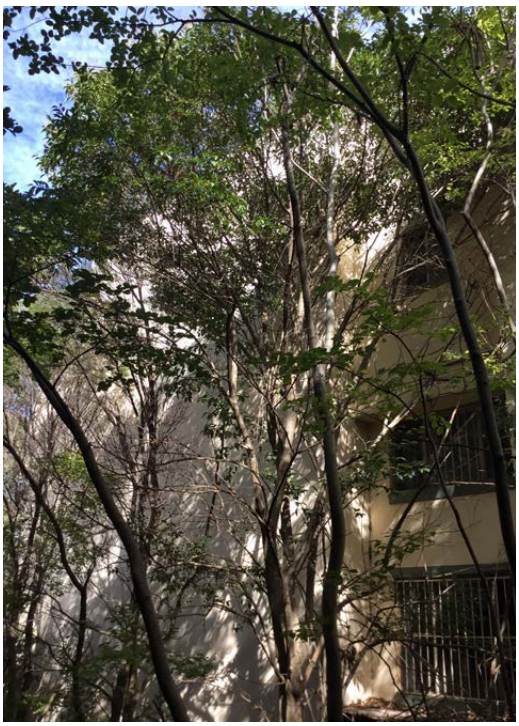

Figure 2.16 – Example of a 'Very Low' value tree - one of the many self-sown Ligustrum lucidum – Broad-leaf Privet (T211) growing within the Precinct, which are in very inappropriate locations, are invasive and should be removed. (Photo: Arterra)

Figure 2.17 – Example of a 'Very Low' value tree - one of the many self-sown Celtis sinensis – Chinese Hackberry (T224) growing within the Precinct, many are in very inappropriate locations, are invasive and should be removed. (Photo: Arterra)

2.5 The Paint Shop Sub-Precinct - Site and Context

The Paint Shop Sub-Precinct is currently highly urbanised and primarily associated with extensive railway infrastructure and transport. It was originally developed between the 1870s and 1930s and is characterised by a variety of railway buildings and sheds. There are large areas of now disused land and railway sidings. Surrounding the sub-precinct is a variety of medium to high density residential developments together with tree-lined streets.

Some significant trees line Wilson Street and some others are located to the east and south of the historic Chief Mechanical Engineers Office building. The Paint Shop Sub-Precinct is otherwise dominated by cleared land and railway infrastructure, with the large and historic Paint Shop building a prominent built structure to the south of the sub-precinct.

Very few trees exist across the entire site of North Eveleigh, however, the Paint Shop Sub Precinct holds the majority of the trees that are within the wider Precinct. Most trees are restricted to the under utilised and poorly maintained spaces between the remaining buildings and on otherwise steep or inaccessible embankments. Most of these are invasive and self sown species which should be removed as part of the re-development.

Figure 2.18 - Photo illustrating Paint Shop, Suburban Car Workshop, and Traverser. (Photo: Arterra).

Figure 2.19 - Photo illustrating the fan of Tracks and the Paint Shop and Suburban Car Workshop illustrating that the majority of the site is historically devoid of trees and other green infrastructure. (Photo: Arterra).

2.6 Site History and Age of Existing Tree Population

From a heritage perspective, the Redfern North Eveleigh Precinct is part of the broader site known as the Eveleigh Railway Workshops, which is listed on the NSW State Heritage Register under Item No. 01140 – Eveleigh Railway Workshops, Great Southern & Western Railway, Redfern. This broader site is the subject of an Overarching Conservation Management Plan, (OCP Architects, 2017 – Eveleigh Railway Workshops – Overarching Conservation Management Plan Rev F – 26 May 2017, Sydney) (CMP). The following key points have been extracted from the above CMP document:

- Eveleigh railway workshops and stores are associated with the phenomenon of railway networks that allowed the unprecedented development of Sydney suburbs and rural NSW at the end of the 1800s and early 1900s. It is one of a limited number of major railway facilities established in the country and the only such facility in NSW of State Significance.
- The historic infrastructure was originally established on both sides of the main rail lines with the Carriage workshops on the north side and the Locomotive workshops on the south side.
- The area is Listed on SHR. No. 01140 – Eveleigh Railway Workshops, Great Southern & Western Railway, Redfern. In particular, under the Section 170 Register (NSW Heritage Act, (Transport for NSW, formerly SRA NSW)) is the listing for The Carriage Workshop and The Chief Mechanical Engineers Office both built in 1877.

Figure 2.20 - Photo illustrating the trees associated with the Chief Mechanical Engineers Building within the Paint Shop Sub-precinct. Numerous weed species are now occurring amongst the larger established trees. These trees hold heritage value and contribute to the current urban canopy. (Photo: Arterra).

Figure 2.21 - In the Paint Shop Sub-precinct, some of the disused lands, where trees are growing, are now subject to extensive growth of weed species and other invasive tree species that commonly develop is such derelict situations. These are mostly still small, but numerous. They mostly include Privet, Camphor Laurel and Chinese Hackberry. (Photo: Arterra).

- The area was once the catchment of Shea's Creek that drained to the Botany Swamps. The native vegetation community would have been largely dominated by Eastern Suburbs Banksia Scrub, which covered much of the sandy area to the east.
- John Whitton, was the Chief Engineer of NSW Railways between 1856-1899 and was responsible for the major restructuring of the railway system which resulted in the resumption of land at Eveleigh and the relocation of the old Redfern Workshops to Eveleigh. During 1882 the area was extensively levelled and regraded to facilitate building of railway sidings.
- In the late 1860s the Eveleigh complex was one of the largest employers within the state. A total of 3720 workers were employed by 1912.
- The 1920s heralded the commencement of the slow decline of Eveleigh, as motor cars and trucks became increasingly more common for transporting goods and passengers. Operations also increased at other railway sites such as Chullora.
- In the 1970s, restrictive work practices, initiated by the Unions, aimed at limiting throughput to preserve jobs, contributed to poor productivity and combined with the inefficiency of the older buildings and facilities resulted in the 1973 decision to 'quit the Eveleigh site'. The Suburban Car Workshop of the Carriage Workshop site was retained until its final closure in 1989.
- In 2008 Carriage Workshops were converted into the Carriage Works multi-arts facility.
- In 2015 The North Eveleigh West affordable housing development was constructed adjacent to the historic Clothing Store building.
- Urban Growth (2017-2019) investigated opportunities for improved public transport, job opportunities, residential & open space facilities.
- The building fabric of Eveleigh Railway Workshops demonstrate the changes in technology and workplace practices for over more than a century. Buildings constructed in the post 1900 period were typically smaller, cheaper, and more temporary structures to accommodate changing needs, in contrast to the architectural quality of the earlier buildings.
- The Clothing Store (General Store) dates to 1913.
- The significant brick retaining wall along Wilson Street dates to 1900-1910.

Today, the area surrounding the Redfern North Eveleigh Precinct is highly urbanised, comprising a variety of housing and commercial typologies. The key features of the area include the Redfern Station transport interchange, the Carriageworks multi-arts precinct and the associated and remaining railway infrastructure. Surrounding development to the north is characterised by historic Victorian period terrace housing and hotels together with a variety of other low, medium and high-density residential buildings and the relatively wide and tree-lined Wilson Street, that defines the northern boundary of the site. Although Wilson Street currently exhibits a 'tree lined character' and makes significant contributions to the overall urban forest of the precinct, there are very few trees throughout the broader site and even fewer still, that may be considered significant and worthy of retention.

The aerial images from 1930 through to 2019 provide a clear visual representation of the stark difference between that earlier period with virtually no trees and that of today with some surrounding tree-lined streets, the extensive invasive trees within some of the under utilised and abandoned areas within the site area.

The majority of the site, being part of the former Eveleigh Carriage Workshops, has been railway infrastructure and an industrial site since the 1880s. The most significant trees remaining on the site from earlier periods are believed to be restricted to those associated with the Chief Mechanical Engineer's Office (CMEO) which was built in 1877.

Historical photographs show the broader site has essentially been devoid of trees for most of its time. The earliest available aerial image from 1930 however, appears also to show what may be row planting of trees located on the southern side of Wilson Street, at what is now the entry to Carriageworks Way. Aerial images from 1956 clearly show trees around the CMEO, a regular planting of street trees along Wilson Street, and the earlier stand of trees at the entry to Carriageworks Way, but still very few trees across the remaining site.

It is the author's opinion that the larger currently remaining Canary Island Date Palms (*Phoenix canariensis*) date to a period around 1930 and the Camphor Laurels probably date to a later period, around 1950 to 1960 when these species were still commonly planted in public landscapes around Sydney. The larger London Plane Trees, associated, with the CMEO and Wilson Street potentially date to around the early 1950s.

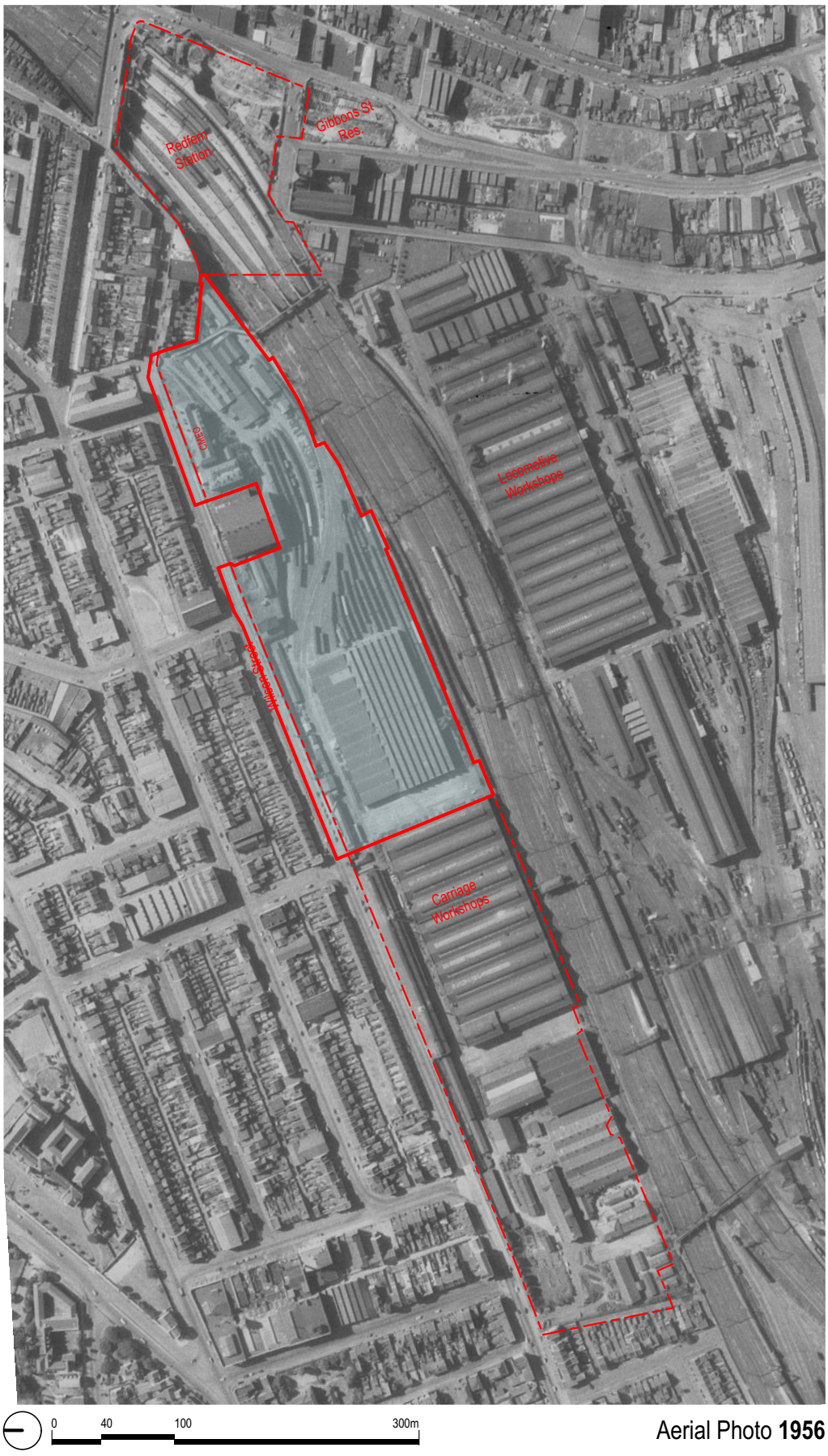

Figure 2.22 – 1956 aerial of the entire North Eveleigh Precinct. Highlighted in blue is the Paint Shop Sub-Precinct and is the focus for this report. (Photo: NSWSSD)

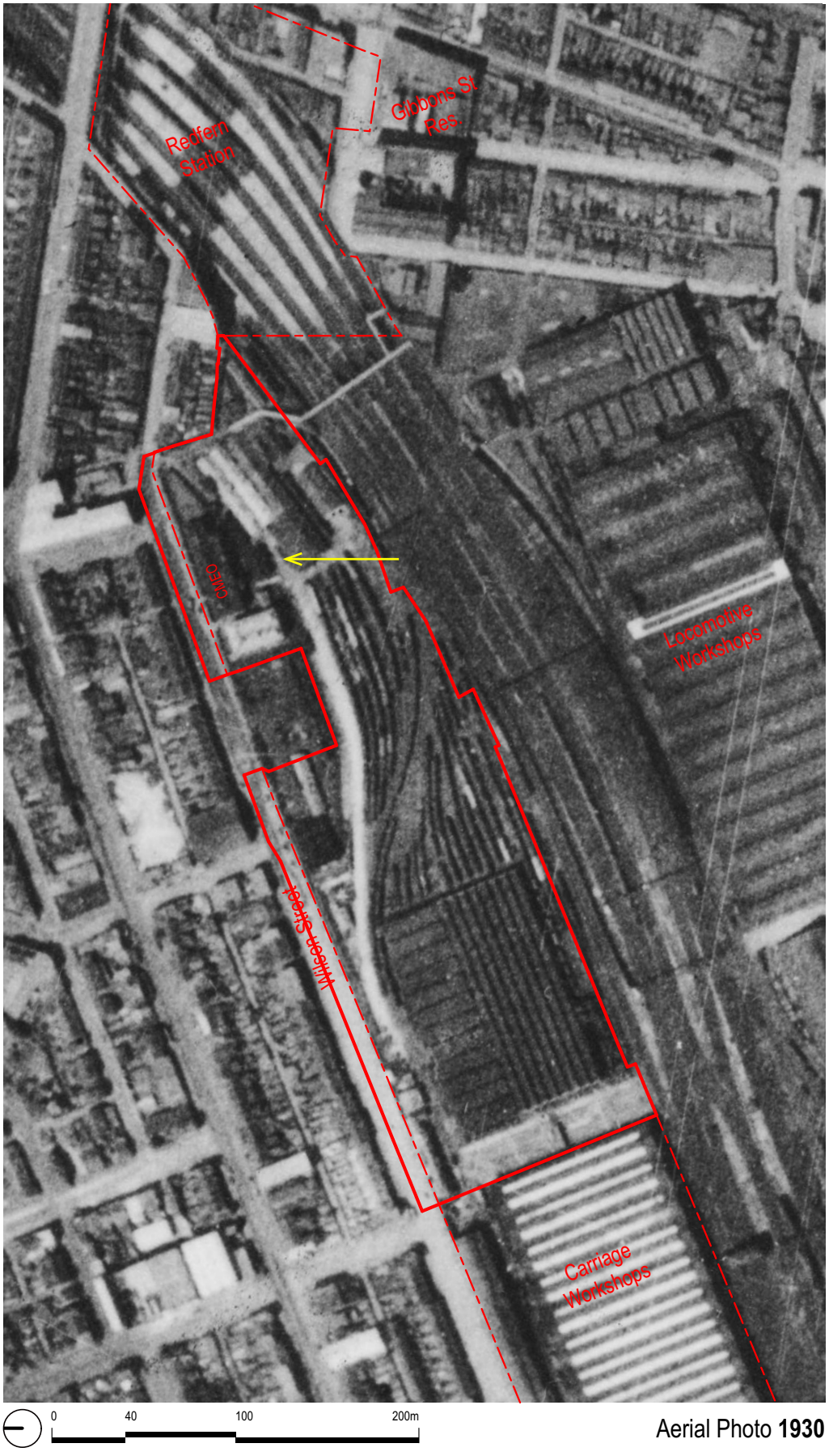

Figure 2.23 – 1930 aerial showing the Paint Shop Sub-precinct highlighted with a solid red outline. A potential stand of trees appear present at the eastern end of site, near the CMEO which has been shown arrowed. There appear to be no other trees of any note present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

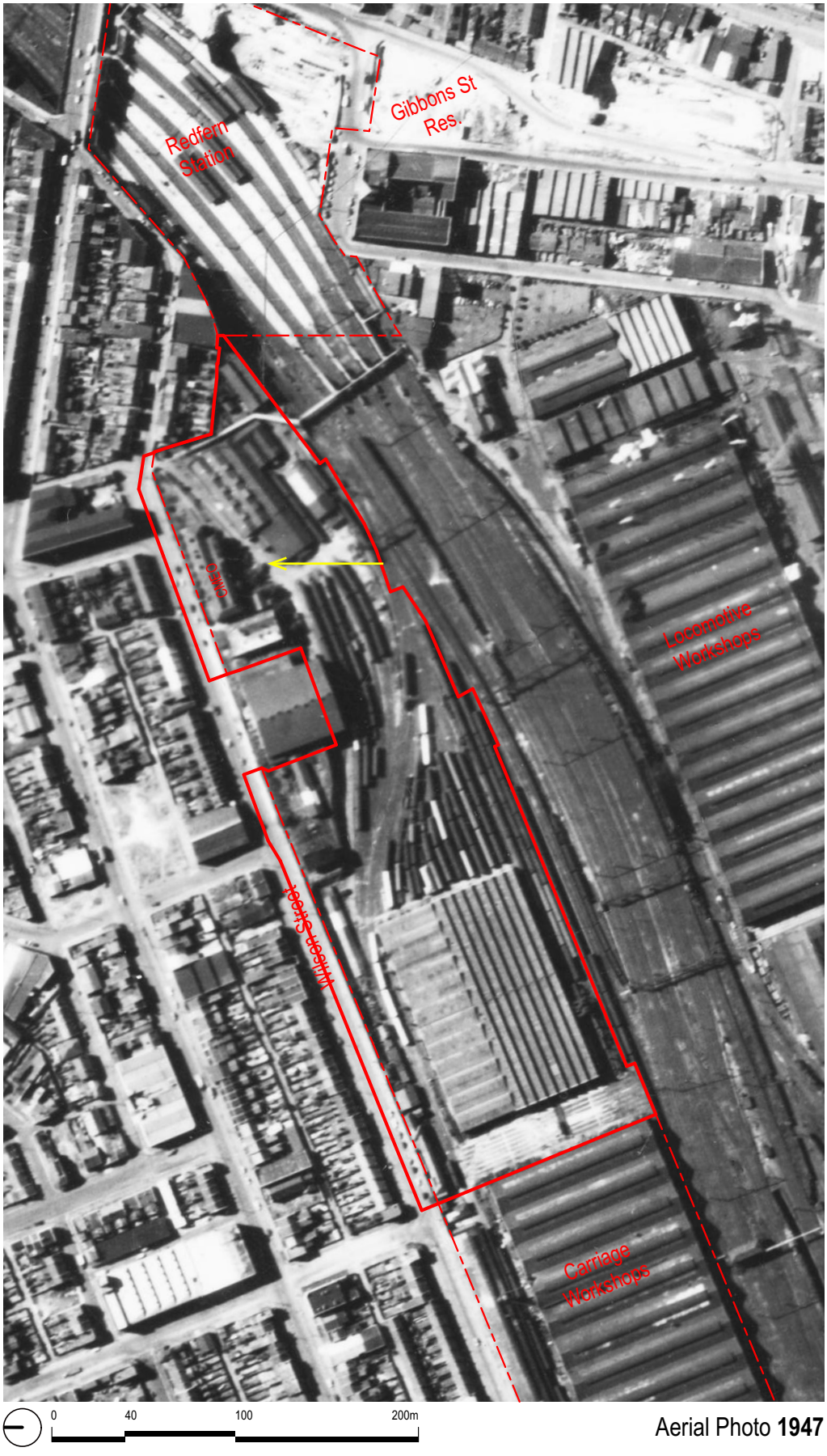

Figure 2.24 – 1947 aerial showing the Paint Shop Sub-precinct highlighted with a solid red outline. A potential stand of trees at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. There appear to be no other trees of any note present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

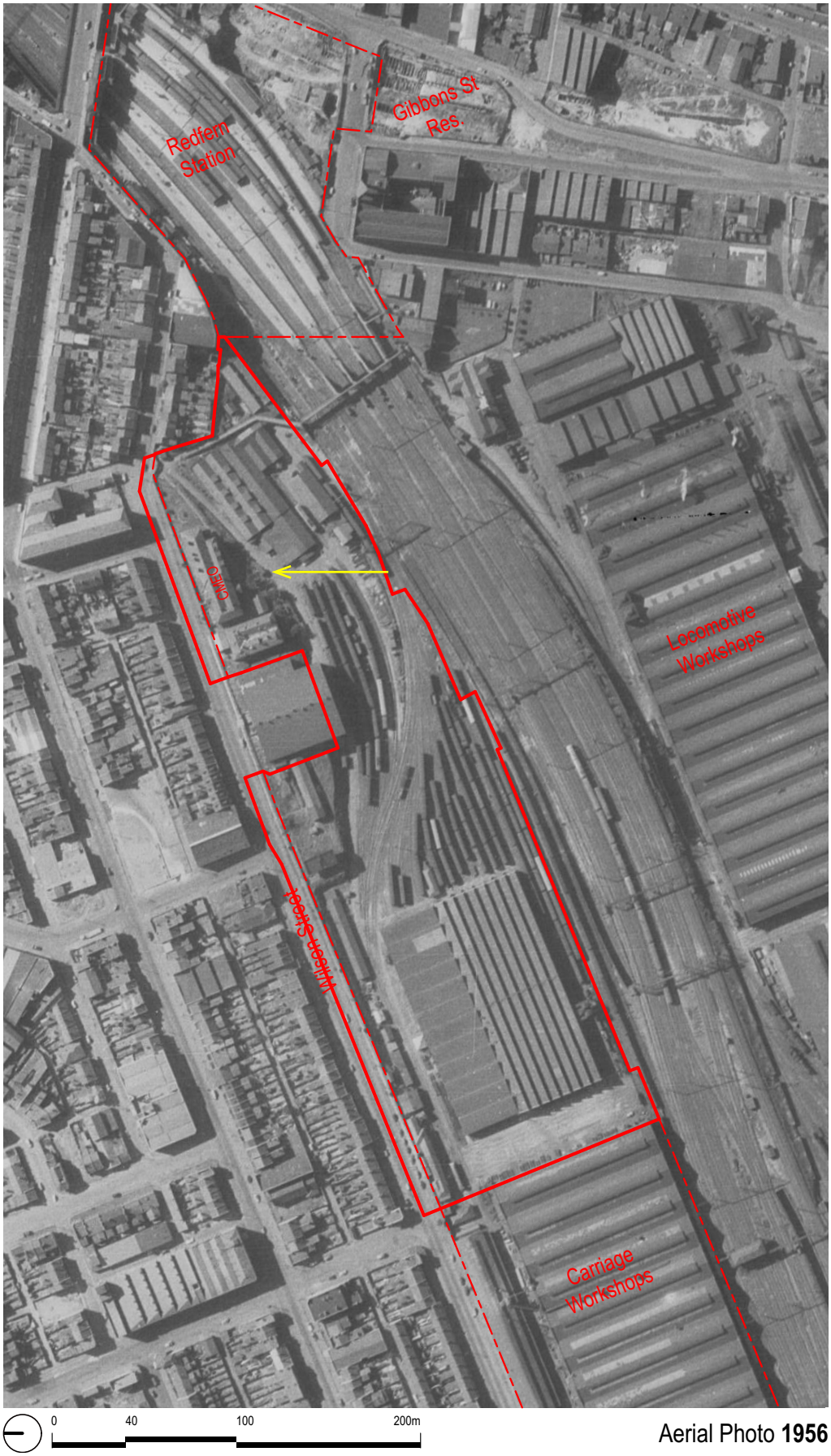

Figure 2.25 – 1956 aerial showing the Paint Shop Sub-Precinct highlighted with a solid red outline. The potential stand of trees at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. There appear to be no other trees of any note present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

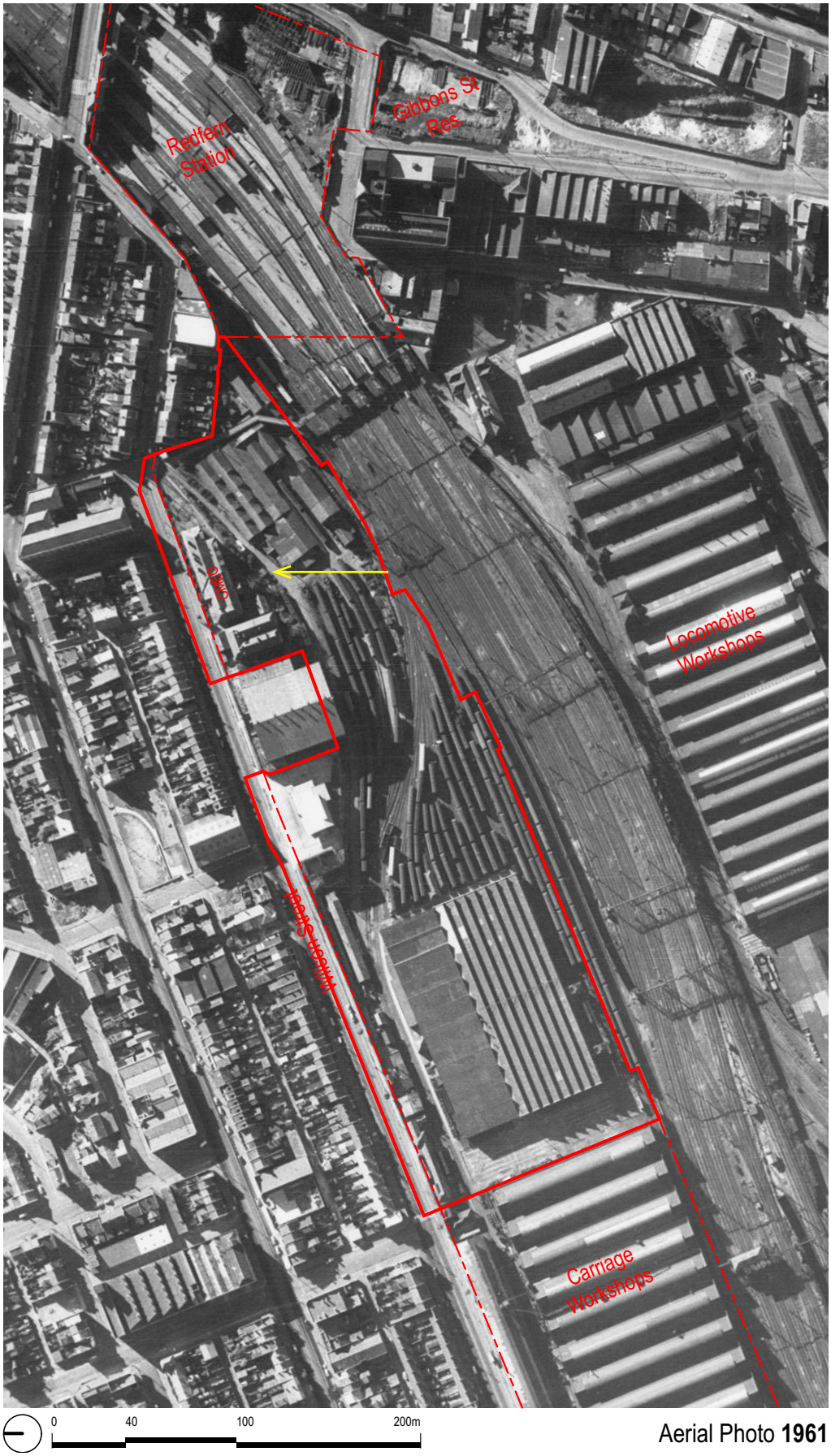

Figure 2.26 – 1961 aerial showing the Paint \Shop Sub-Precinct highlighted with a solid red outline. The potential stand of trees at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. Canary Island Dates Palms can be seen associated with the CMEO. There appear to be no other trees of any note present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

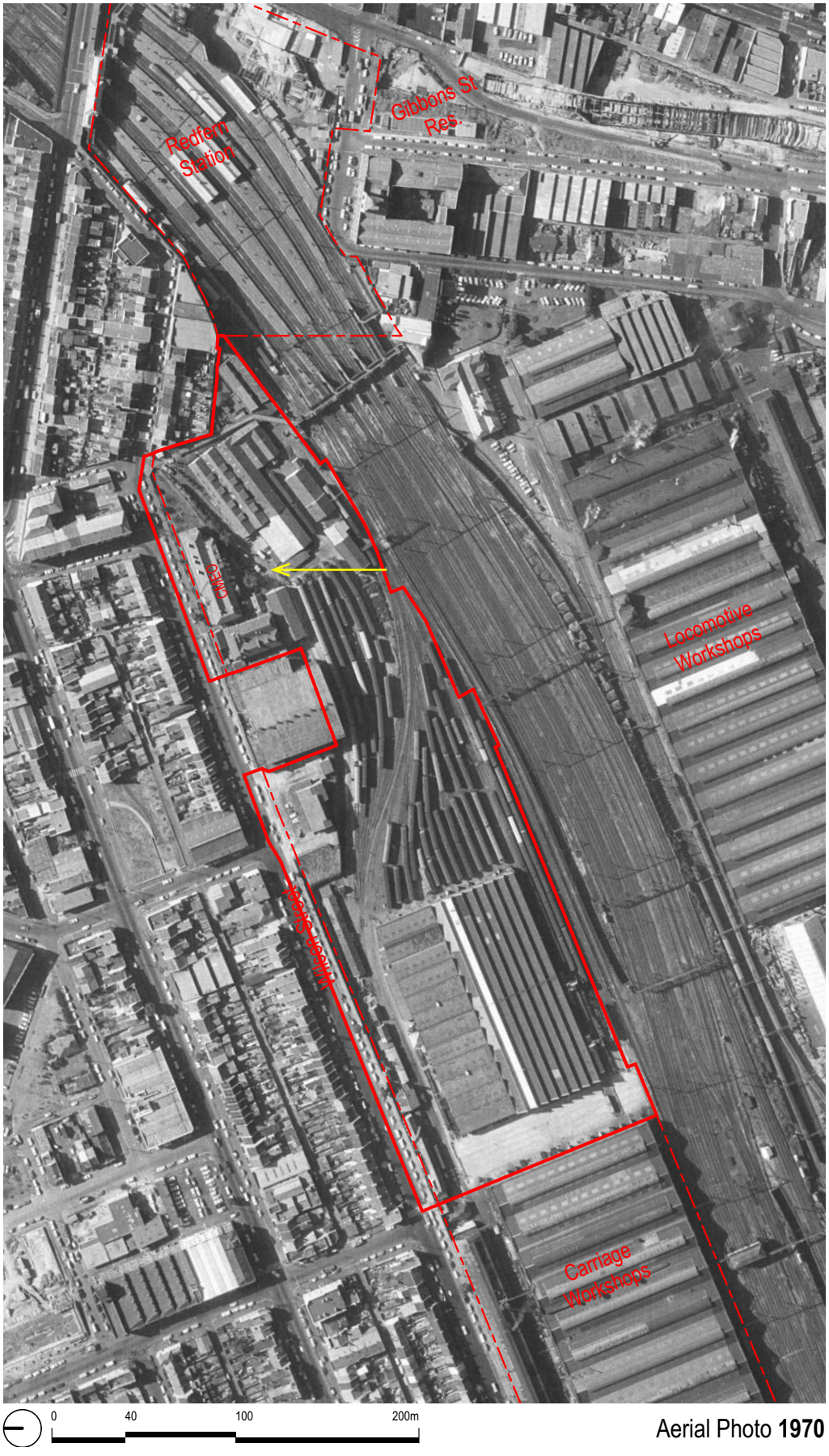

Figure 2.27 – 1970 aerial showing the Paint Shop Sub-Precinct highlighted with a solid red outline. The potential stand of trees at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. There appear to be no other trees of any note present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

Figure 2.28 – 1986 aerial showing the Paint Shop Sub-Precinct highlighted with a solid red outline. The potential stand of trees at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. There appear to be more street trees along Wilson Street together with the originally planted trees which probably are the large London Plane Trees still present today. No other trees of any note are present across the Paint Shop Sub-Precinct at this period. (Photo: NSWSSD)

Figure 2.29 – 2010 aerial showing the Paint Shop Sub-Precinct highlighted with a solid red outline. The potential stand of trees, evident in the 1930 aerial at the eastern end of site, near the CMEO, appear to still be displayed and are shown arrowed. There appear to be numerous street trees along Wilson Street. Self sown weedy species appear to be taking over in underutilised areas of the Precinct at this period. (Photo: NearMap)`

Figure 2.30 – Current day 2019 aerial showing the Paint Shop Sub-Precinct highlighted with a solid red outline. The aerial still displaying potential 1930 stand of trees at eastern end of the site, near the CMEO. Significant and numerous street trees along Wilson Street. Self sown weedy species clearly prominent in other under utilised areas of the Sub-Precinct. (Photo: NearMap)

Figure 2.31 – Photo of Eveleigh Carriage Workshop circa 1930. Since the sites very beginnings, in the 1870s, the primary functions and purpose of the Eveleigh area centred around the railway infrastructure and industry. Trees had very little place or significance in this industrial landscape. The only significant tree planting that remain associated with the early site today are the Brush Box trees adjacent to Wilson Street at the south-western corner of the wide Pecinct and some of the larger trees and palms associated with the Chief Mechanical Engineers Office dating from approximately the 1930s to the 1950s, that are now located within what is now referred to as the Paint Shop Sub-Precinct. (Source: SLNSW - d1_08116h)

Figure 2.32 – Aerial oblique view of the Eveleigh railway workshops and Redfern Station in 1968 photographed by Milton Kent. (Source: SLNSW - FL8812694)

Figure 2.33 – Photo of the Chief Mechanical Engineers Office believed to be circa early 1920s. Although the trees that can be seen in this photo probably no longer exist, it is the authors opinion that the larger and currently remaining Canary Island Date Palms date to a period just after this photo, possibly around 1930 and the larger Camphor Laurels probably date to a period around 1940 to 1950 when these species were still commonly planted in public landscapes around Sydney (Source: Central to Eveleigh Facebook page and Caldis Cook - CMEO CMP, 1997)

Figure 2.34 – Photo of Wilson Street near the blacksmiths shop looking north in 1960 illustrating the potential timing of the London Plane Trees and Brush Box along the street which can be seen here as newly planted specimens and can be seen in the 1956 aerial photos. It is assumed they were therefore planted around mid 1950s in an effort to improve amenity and urban beautification. (Source: CoS Archives - SRC18944)

Figure 2.35 – The large trees associated with the Chief Mechanical Engineers Office are some of the larger and more important trees with the Precinct site, such as the Camphor Laurel to the left, the Canary Island Date Palms centre and the more recent but now large Eucalyptus microcorys (Tallowwood) to the right. These trees should be a focus for retention throughout any redevelopment. (Photo: Arterra)

Figure 2.36 – The large Camphor Laurel tree and Canary Island Date Palm associated with the Chief Mechanical Engineers Office. These trees should be a focus for retention throughout any redevelopment. (Photo: Arterra)

2.7 Soils, Landform and Natural Vegetation

The site would have had a naturally slightly undulating landform. This has been extensively modified and disturbed since the late 1800s to create the very large and levelled areas for development of the railways and the infrastructure for heavy equipment manufacturing associated with the Redfern locomotive and carriage workshops. The broader site within the boundaries of the railway lands is now very flat, having been excavated and levelled to accommodate the infrastructure. Due to this levelling, steep batters and retaining walls, some more than 4-5 metres high in places, run along much of the northern 'Carriageworks' site boundary, adjacent to Wilson Street, and also behind the terrace houses of Little Eveleigh Street.

The slopes of the surrounding streetscapes and public open spaces outside of the rail infrastructure lands are typically only slight to moderately sloping and not currently considered a limiting factor in terms of the existing or future tree population.

The natural geology of the site is common throughout the inner west of Sydney where the Blacktown Soil Landscape Association was once dominant. This soil landscape is characterised by gently undulating landforms on Wianamatta Group shales and Hawkesbury shales, with local relief to 30 metre and slopes generally less than 5%. The natural soil landscape only warrants passing comment as the soil profile across the site have been very highly modified due to the varied history of the site and the extensive earthworks associated with the development of the railway corridor and work sheds.

The naturally occurring soils would have been typically a very well defined Brown Podzolic soil. The topsoil horizon would have been well defined, moist, dark brown and friable. It was likely to have been relatively deep at 450-550 millimetres depth, and the pH neutral at 7.0. The texture of the topsoil would have been clay / silty clay loam with a very low proportion of sand particles and a very high proportion of clay. It would have been very plastic when wet.

The soil would have typically displayed increasing acidity moving downward through the profile becoming quite acid in the subsoil, probably recording a pH of 5.0 - 5.5. (Chapman 1989).

The natural soils would have typically had very good water holding capacity and may be subject to waterlogging. It would have good cation exchange capacity (CEC) and although naturally low fertility, it would have good nutrient holding capacity if fertilizers were applied. The high clay contents of both the topsoil and subsoils however make the soils highly subject to compaction if trafficked when wet and would then set hard when dry. This may often lead to difficulty in them absorbing surface water and soil oxygenation.

Figure 2.37 – This exposed embankment near Wilson Street provides a very good indication of the naturally occurring clay soils that would have occurred throughout much of the site. This profile is reflective of the common and extensive Blacktown Soil Landscape Association. The clay soils can be favourable to tree growth but also present problems in terms of potential compaction and waterlogging. (Photo: Arterra)

Figure 2.38 – Photo illustrating the extensive levelling for the railway development and the creation of the large workshops and other sheds. Most existing soils are anticipated to have been substantially altered and lost during this process and replanting will require extensive intervention and efforts to recreate suitable growing conditions for new trees. (Photo: Arterra)

The current soil conditions of the Redfern North Eveleigh Precinct potentially present one of the greatest challenges to successful future tree planting due to the:

- Absence of the natural occurring and horticulturally suitable soils
- High clay contents and potential for waterlogging due to clay subsoils and compacted and unnatural sub-grades and the proximity to dense shale and underlying rock strata
- Low fertility
- Acidic pH
- Potential for soils to have been contaminated by previous site uses and chemical pollutants.

In these particularly clay based soil conditions, major tree roots will often be confined to the top 300-400 millimetres of the profile and cause greater impacts with pavements, kerbs and footings resulting in pronounced damage once mature. This is clearly displayed by many of the existing larger street trees located along Wilson Street.

The natural vegetation has all been cleared and no remnant vegetation was observed. The natural vegetation community on the clay soils of the site would have most likely been that of Turpentine Ironbark forests. To the immediate east would have been the Eastern Suburbs Banksia Scrub, associated with the nearby sands of the Tuggerah Soil Landscape Association. This only becomes evident and relevant east of Gibbons Street, and outside of the Paint Shop Sub-Precinct. The Turpentine–Ironbark Forest is listed as a critically endangered ecological community under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and is also recognised as an endangered ecological community under the NSW Biodiversity Conservation Act 2016. Less than 5 percent of this community still remains. The primary tree species of this community around Redfern would have been:

- *Eucalyptus paniculata* (Grey Ironbark)
- *Eucalyptus saligna* (Sydney Blue Gum)
- *Eucalyptus gummifera* (Red Bloodwood)
- *Eucalyptus punctata* (Grey Gum)
- *Syncarpia glomulifera* (Turpentine)
- *Angophora costata* (Smooth-barked Apple)

2.8 Climate and Microclimate

The Redfern North Eveleigh Precinct experiences moderate temperatures, good rainfall and minimal climatic and weather extremes. It is typically described as a 'temperate' climate with hot to warm summers and cool winters, with relatively uniform rainfalls across the seasons. There is no distinctly dry season. It is located very close to the moderating affects of the coast. The average annual rainfall is 1085 millimetres, and is fairly evenly spread across the year but with a slightly drier period from July - October. The highest rainfall usually occurs in June with an average of 123 millimetres and the driest month is September with an average of just 60 millimetres (figures according to the Sydney Airport AMO weather recording station).

Maximum average daily temperatures, recorded range from 26.5°C in January to 17°C in July. The minimum average daily temperatures range from a low of 19°C in February down to lows of 7.2°C in July. Frosts are extremely rare.

The primary wind direction is from the north-east to south-east in the afternoons while it is predominantly from the west and north-west in the mornings. This is common of coastal areas dominated by 'sea breeze' affects. The strongest winds (>30km/h) are normally experienced from the south-east and southerly directions and later in the day. (Source: Australian Bureau of Meteorology).

In comparison with other areas of the greater western Sydney region, that experience much higher maximum and lower minimum temperatures and substantially lower annual rainfall, the Redfern North Eveleigh Precinct currently enjoys a reasonably comfortable climate which in turn lends itself to a very diverse range of tree species that will happily grow in the area. There are no noticeable microclimatic influences in the area apart from the overshadowing of existing and potential tower blocks and the associated wind funnelling and down drafts that may be experienced from any adjoining tall towers.

The potential impacts of climate change should be considered, which is likely to result in higher average temperatures, longer drought periods and increased extreme storm events. Planting selections, therefore, should consider these additional factors.

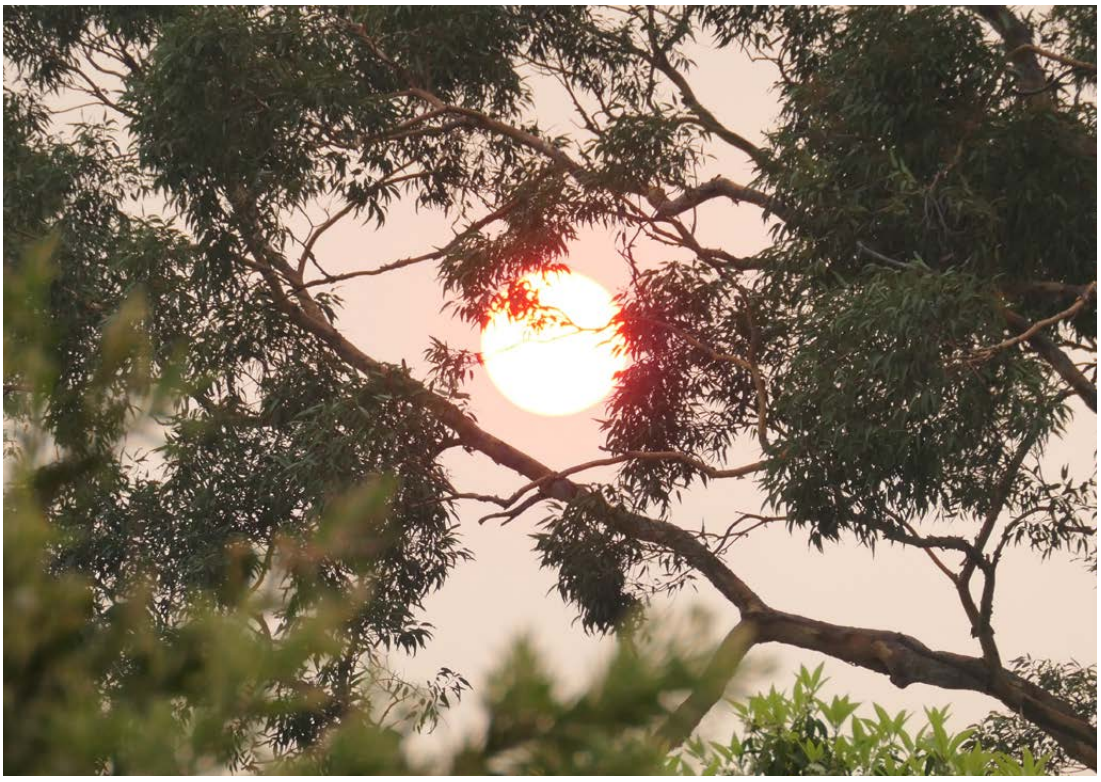

Figure 2.39 - Canopy trees help to cool through shading and evaporative cooling, and can help mitigate adverse affects from weather extremes and storms. (Photo: Arterra)

2.9 Existing Tree Population and Statistics

Within the Redfern North Eveleigh Paint Shop Sub-Precinct area, a total of 173 existing trees were identified, inspected and assessed. The trees are predominantly located in the streets and the areas immediately surrounding the current railway buildings and infrastructure. Although there are numerous trees scattered throughout the areas adjacent to the remaining buildings, the vast majority of these are considered weeds and other generally invasive species and therefore represent undesirable trees to retain, moving forward. In summary:

- There are currently **173 trees** within, and immediately adjacent, the Paint Shop Sub-Precinct.
- **53** (31%) are street trees, mainly along Wilson Street.
- The existing 'overall' tree canopy coverage for the Sub-Precinct currently stands at only **10.3%**. This includes the southern side of Wilson Street. If this is excluded then the tree canopy coverage is **only 7%**
- The majority of the 'High and Moderate Value' trees are directly related to Wilson Street or the historic Chief Mechanical Engineer's building curtilage.
- It is believed that the larger and currently remaining Canary Island Date Palms (*Phoenix canariensis*), adjacent the Chief Mechnical Engineers Building, are the oldest remaining trees associated with the Sub-Precinct and probably date to around 1930. The larger Camphor Laurels (*Cinnamomum camphora*), appear to date to a period around 1950-60s when these species were still commonly planted in some public landscapes around Sydney, therefore still having some heritage significance. The other trees appear to date to the 1970s and 1980s, with the extensive weed population of the site proliferating over the more recent decades.
- The current tree population is dominated by only 4-5 main 'Families'. The most dominant is Ulmacaeae, at 38% of the total population. This family is associated with the prevalent weed species Chinese Hackberry (*Celtis sinensis*).
- Tree Retention Values. The individual number and the percentage of the total population of trees in the different retention value ratings are:-
    - **4** are High (2%)
    - **43** are Moderate (25%)
    - **54** are Low (31%)
    - **72** are Very Low / Remove (42%)
- With regard to the **4 High** Value trees, they are represented by the following species:-
    - 1 x *Cinnamomum camphora* (Camphor Laurel) (T208)
    - 1 x *Phoenix canariensis* (Canary Island Date Palm) (T209)
    - 1 x *Platanus x acerifolia* (London Plane) (T49)
    - 1 x *Eucalyptus microcorys* (Tallowood) (T204)

The following statistics and commentary relate specifically to the area defined as the Paint Shop Sub-Precinct. This information is intended to provide a background to the existing urban forest and provide an analysis and understanding of existing tree population within the boundary of this Sub-Precinct. The information is provided to support the overall recommendations made for the sub-precinct. Although trees adjoining the Paint Shop Sub Precinct boundary, which are located within and adjacent the wider North Eveleigh Precinct, were also reviewed and assessed, for clarity, they are not included within the following statistics.

Although **173 trees** were identified, inspected and assessed, in the case of this sub-precinct it makes sense to consider the population of the existing streets somewhat separately to the remaining site areas. The trees have therefore been divided into two broad categories being; 'Street Trees' generally under the control of the City of Sydney (CoS trees) and 'Other Trees' across the broader site. Street trees are considered to be trees that are under the care and control of the City of Sydney and it is typically assumed they will be required to be retained and protected during the course of the redevelopment.

The two groups are analysed in more detail in the following tables. The following analysis has also broken up the 'entire' tree population into their different families, genus and retention values. These have been used to assess the existing tree population against the expected CoS targets. Corresponding plans in Figure 2.40 visually display how the existing trees are distributed across the site, which has helped to identify key trees and groups of trees to be included and protected within the proposed Master Plan.

2.9.1 Existing Species Composition.

There are currently **40** different species within the study area. The species are illustrated in the following tables which are divided into street and other trees.

Table 2 – Existing Street Trees By Species

Species Name	Common Name	Number of Trees	% Population
Koelreuteria paniculata	Golden Rain Tree	8	15%
Casuarina cunninghamiana	River She-Oak	7	13%
Platanus x acerifolia	London Plane	6	11%
Lophostemon confertus	Brush Box	6	11%
Eucalyptus botryoides	Bangalay	2	4%
Eucalyptus sideroxylon	Mugga Ironbark	2	4%
Hymenosporum flavum	Native Frangipani	2	4%
Eucalyptus cladocalyx	Sugar Gum	2	4%
Melia azedarach	White Cedar	2	4%
Eucalyptus nicholii	Narrow-leaved Black Peppermint	2	4%
Schinus areira	Peppercorn Tree	2	4%
Eucalyptus punctata	Grey Gum	1	2%
Koelreuteria bipinnata	Chinese Rain Tree	1	2%
Eucalyptus camaldulensis	River Red Gum	1	2%
Corymbia citriodora	Lemon Scented Gum	1	2%
Callistemon viminalis cv.	Weeping Bottlebrush	1	2%
Ficus benjamina	Weeping Fig	1	2%
Melaleuca styphelioides	Prickly Paperbark	1	2%
Grevillea robusta	Silky Oak	1	2%
Agonis flexuosa	Willow Myrtle	1	2%
Eucalyptus grandis	Flooded Gum	1	2%
Eucalyptus robusta	Swamp Mahogany	1	2%
Eucalyptus saligna	Sydney Blue Gum	1	2%
	Total Street Trees	**53**	**100%**

Table 3 – Street Trees and Their Distribution By Street

These are the figures for all street trees divided into the streets in which they relate.

Location / Precinct	Number of Trees	Percentage of Population
Wilson Street	51	96%
Little Eveleigh Street	2	4%
Total Street Trees	**53**	**100%**

Table 4 – Existing Other Trees By Species

These are the trees throughout the rest of the site that are not 'street' trees under the control of the CoS.

Species Name	Common Name	Number of Trees	% of Population
Celtis sinensis	Chinese Hackberry	66	55%
Melaleuca bracteata	Black Tea-Tree	8	7%
Callistemon viminalis cv.	Weeping Bottlebrush	7	6%
Eucalyptus saligna	Sydney Blue Gum	6	5%
Phoenix canariensis	Canary Island Date Palm	3	3%
Ficus rubiginosa	Port Jackson Fig	3	3%
Eucalyptus punctata	Grey Gum	3	3%
Platanus x acerifolia	London Plane	3	3%
Sapium sebiferum	Chinese Tallow Tree	2	2%
Cinnamomum camphora	Camphor Laurel	2	2%

Cupressus macrocarpa	Monterey Cypress	2	2%
Eriobotrya japonica	Loquat	2	2%
Eucalyptus microcorys	Tallowood	2	2%
Acacia parramattensis	Parramatta Wattle	2	2%
Araucaria heterophylla	Norfolk Island Pine	1	1%
Casuarina cunninghamiana	River She-Oak	1	1%
Eucalyptus scoparia	Wallangarra White Gum	1	1%
Ligustrum lucidum	Broadleaf Privet	1	1%
Jacaranda mimosifolia	Jacaranda	1	1%
Eucalyptus pilularis ?	Blackbutt	1	1%
Syagrus romanzoffiana	Queen Palm	1	1%
Malus sp.	Apple or Crabapple	1	1%
Grevillea robusta	Silky Oak	1	1%
	Total Other Site Trees	**120**	**100%**

The following analysis has broken up the 'total' existing tree population into the different families, genus, species and retention values. These will be used to assess the existing tree population against any CoS or other authority targets.

2.9.2 Existing Tree Family Distribution.

The tree population is dominated by 4-5 main 'Families'. The percentage of the population they represent is illustrated in the following table. The preferred CoS target is to have no more than 40% of one family. As expected, and is very common through most Australian cities, Myrtaceae dominates at 29% of the total population. The others appear to be within expected targets. The Ulmaceae percentage should be ignored as this is skewed by the excessive numbers of self sown weed species (*Celtis sinensis*).

Table 5 – All Trees By Botanic Family

Botanical Families	Number of Trees.	% of Total Population.
ULMACAEAE (eg Celtis)	66	38%
MYRTACEAE (eg. Eucalypts, Corymbia, Tristaniopsis, Melaleuca, Lophostemon, Waterhousea)	51	29%
SAPINDACEAE (eg. Koelreutaria , Sapium)	11	6%
PLATANACEAE (eg. Planes)	9	5%
CASUARINACEAE (eg. Casuarina)	8	5%
ARECACEAE (eg. Palms)	4	2%
MORACEAE (eg. Figs)	4	2%
ROSACEAE	3	2%
FABACEAE (eg. Robinia, Acacia)	2	1%
PROTEACEAE	2	1%
LAURACEAE	2	1%
CUPRESSACEAE	2	1%
PITTOSPORACEAE (eg. Pittosporum)	2	1%
ANACARDIACEAE	2	1%
MELIACEAE	2	1%
BIGNONIACEAE	1	1%
OLEACEAE (eg. Olives, Privet)	1	1%
ARAUCARIACEAE	1	1%
Grand Total	**173**	**100.00%**

2.9.3 Existing Genus Distribution.

There are currently 26 different genus' within the study area. The CoS target is to have no more than 30% in any one genus. The top 10 genus' are represented in the table below. The most common genus within the site is *Celtis* (38%), represented by *Celtis sinensis*, which is a recognised invasive species, commonly found adjacent to rail lines throughout Sydney. As is common in many Australian cities, the *Eucalyptus* genus currently dominates the street tree and public open space plantings at approximately 15% of the total tree population.

Table 6 – Existing Trees By Botanic Genus

Most Prevalent Genus (Top 10 in order of prevalence)	Number of Trees.	% of Total Population.
Celtis	66	38%
Eucalyptus	26	15%
Melaleuca	9	5%
Koelreuteria	9	5%
Platanus	9	5%
Casuarina	8	5%
Callistemon	8	5%
Lophostemon	6	3%
Ficus	4	2%
Phoenix	3	2%

2.9.4 Existing Tree Retention Values.

The number and the percentage of the total population of trees in the different retention values are shown in the following table.

Table 7 – Existing Trees By Retention Value

Retention Value	Number of Trees.	Percentage of Total Population.
High	4	2%
Moderate	43	25%
Low	54	31%
Very Low / Remove	72	42%
Total Trees	**173**	**100%**

'High' retention value trees are represented by the following species:-

- 1 x *Cinnamomum camphora* (Camphor Laurel)
- 1 x *Phoenix canariensis* (Canary Island Date Palm)
- 1 x *Platanus x acerifolia* (London Plane)
- 1 *x Eucalyptus microcorys* (Tallowood)

Refer to accompanying Tree Retention Values Plan (Figure 2.40 on the following page) for a graphical representation of the tree retention values and their distribution around the site with the majority of moderate value trees represented by the street trees along Wilson Street and species such as:

- *Platanus x acerifolia* (London Plane)
- *Eucalyptus microcorys* (Tallowood)
- *Lophostemon confertus*(Brush Box)
- *Eucalyptus botyoides* (Bangalay)
- *Eucalyptus saligna* (Sydney Blue Gum) and
- *Corymbia citriodora* (Lemon Scented Gum).

Figure 2.40 – Map of the Precinct illustrating the existing trees and their relative positions and retention values . (Source: Arterra)

2.9.5 Existing Tree Age Class, Origin and Vigour.

The tree population represents what would be considered a relatively normal breakup of age class, size and origin. Apart from the over representation of invasive species, none of these statistically represent a great cause for concern and the existing population provides a good basis upon which to create a sustainable urban forest strategy moving forward, once the undesirable species are removed and controlled.

With regard to age of the population, the majority of trees fall into the mature age class. A good representation of semi-mature trees, however, is also present. Most importantly, there is very little evidence of an over-mature or senescent tree population that needs to be specifically addressed as part of any immediate strategy. The new development is likely to introduce another wave of young tree planting that will help balance the age classes of the urban forest population for the foreseeable future.

Table 8 – Existing Trees By Age Class

Existing Tree Age Class	No.	% total pop.
Young	14	8%
Semi-mature	72	42%
Mature	75	53%
Over-mature	12	7%
Total	**173**	**100%**

Table 9 – Existing Trees By Origin of Tree

Existing Tree – Tree Origin	No.	% total pop.
Endemic (native to Sydney Region)	24	14%
Native (native to Australia)	44	25%
Exotic	34	20%
Invasive (environmental weed, easily self sown)	70	40%
Weed (recognised Noxious weed)	1	1%
Total	**173**	**100%**

Table 10 – Existing Trees By Vigour and Condition

Existing Tree – Vigour and Condition	No.	% total pop.
Excellent	1	<1%
Good	64	37%
Fair	93	54%
Poor	14	8%
Moribund	1	<1%
Total	**173**	**100%**

2.9.6 Existing Canopy Cover

Current analysis of tree canopy coverage within the Paint Shop Sub-Precinct is broken down in the following table. Refer also to following Tree Canopy Cover Plan (Figure 2.41). Of greatest note is the pleasing 49.8% coverage that the existing trees provide to street areas, primarily to Wilson Street.

Table 11 – Existing Canopy Cover Analysis**

Study Area	Total Area	Canopy m2	% total canopy	CoS 2050 target.
Parks / Reserves	0 (0.0ha)	0m2	0%	46%
Private	51,592m2 (5.1ha)	3,750m2	7.3%	20%
Streets	3,746m2 (0.5ha)	1,867m2	49.8%	34%
Total	**55,338m2(5.6ha)**	**5,617m2**	**10.2%**	**27%**

** Note - Area calculations include the Paint Shop Sub-Precinct only. All areas within the sub-precinct have been included, including the portions of the road reserves adjacent to the sub-precinct boundary up to the centre line of the relevant road (eg. Wilson Street).

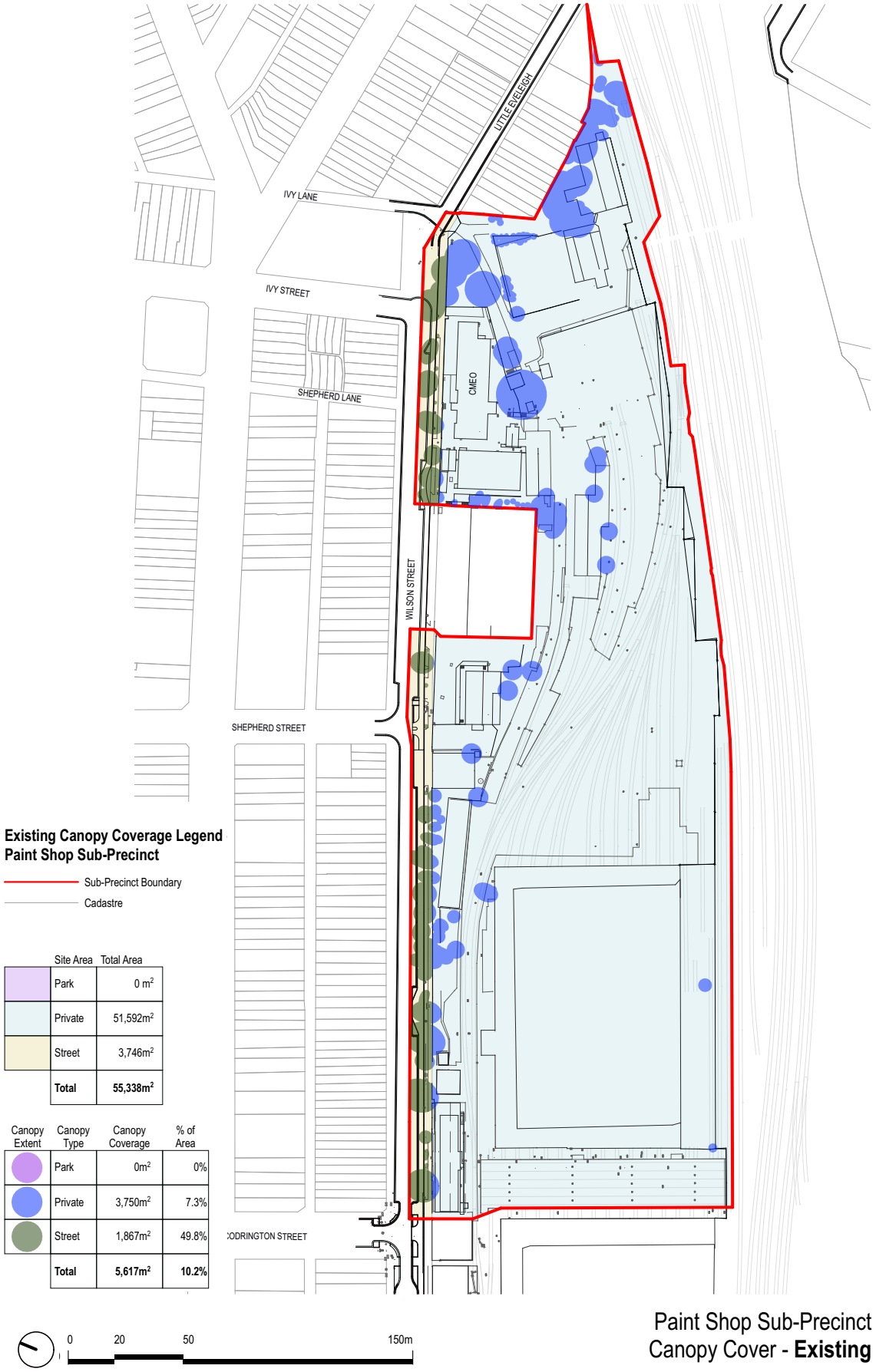

Figure 2.41 – Map of the Precinct illustrating the existing trees and the calculated canopy coverage . (Source: Arterra)

2.10 Position of Existing Trees Within the Precinct

The trees are concentrated in certain areas in the Paint Shop Sub-Precinct. As can be seen in the preceding figures (Figures 2.40 and 2.41), this is mainly within the roadside verges and in the gardens surrounding certain buildings. Most of the more significant and important trees are often located either in the existing Wilson Street road verge or within the immediate curtilage of the existing buildings to the north of the site. Some key points to note include:

- **Larger Scale Trees**. The larger trees such as the *Platanus x acerifolia* (London Plane Trees) and *Eucalypt sp. and Corymbia* sp. dominate much of the surrounding streets and open areas. The *Cinnamonum camphora* (Camphor Laurel Tree) related to the Chief Mechanical Engineers Office building is one of the largest trees on the site. They will all require ample space both above and below ground in order to retain and protect them.
- **Self Sown Trees and Infrastructure**. Many self sown trees often occur in very close proximity to buildings and other infrastructure. This has often created issues with the form and habit of the individual trees and presents conflicts with the surrounding infrastructure such as footpaths, walls, buildings and below ground drainage lines. Where growing adjacent to historic structures these trees should be removed to prevent degradation and damage to the structure. Likewise, it will be impossible to demolish some of the existing buildings and structures without first removing the trees. Substantial thickets of weeds and other trees also grow on most of the somewhat inaccessible and steep embankments. It is likely these level changes will need to be addressed and formalised as part of any re-development and therefore the trees in these areas will not be able to be retained.
- **Protection Zones.** Many of the more important trees have large trunk diameters and will therefore require extensive setbacks and tree protection zones in order to adequately protect them. Refer to the Appendix at 6.1 and 6.3 for detailed measurements and graphical representations.

2.11 General Summary of the Existing Tree Population

The following summaries the key findings from the analysis of the field assessments and statistics.

- **Composition by family, genus and species**. The composition of the tree population by species and family is approaching some 'best practice' targets. Of main concern, care will be needed when selecting species from the Myrtaceae family to prevent further skewing and representation of this family. Current targets advocated by the CoS, and others, state that a single family should make up no more than 40% of the population and no individual species should represent more than 10%.
- **Invasive Species and Retention Values**. The composition of the tree population is very skewed by self-sown invasive species such as the Celtis. These are undesirable trees and should be removed, hence they have been given a Low or Very Low Retention Value. Once removed many of the statistics will normalise and provide a far better reflection of a preferred urban forest.
- **Age Distribution and Health**. The current population is relatively balanced. The likelihood of new tree planting as a result of the redevelopment will maintain the age distribution of the urban forest at acceptable levels. Maintaining an appropriate distribution within age classes of the population allows a balanced approach to maintaining and improving canopy cover over time. Mature trees typically provide the greatest benefits in terms of canopy, however it is also important to remember that trees take many years to grow and provide the benefits of the mature tree. Trees will also grow old and eventually require removal, meaning that ongoing and relatively continuous planting is always required to maintain and improve canopy coverage and age class distribution into the future.
- **Canopy Cover**. The current canopy cover is relatively low and well below most of the recommended targets which are commonly espoused by Authorities and Councils. The removal of the invasive species and other low and very low value trees will further reduce the canopy coverage. Retaining the larger, high value trees helps retain the canopy and immediately provides all the benefits (environmental, canopy, amenity, scale and aesthetics) of big trees to a new development. Removal of large canopy trees will have a corresponding negative effect and take many years to ameliorate and offset the losses. To achieve the stated aims of the precinct redevelopment, canopy coverage targets will be crucial. Extensive efforts to maintain the important existing trees should occur and numerous additional trees should be planted as part of the re-development.

3. PLANNING FRAMEWORK AND MASTER PLAN PROPOSAL

3.1 Project Description

An Urban Design and Public Domain Study has been prepared to establish the urban design framework for the Redfern North Eveleigh Paint Shop Sub-Precinct. The Urban Design and Public Domain Study provides a comprehensive urban design vision and strategy to guide future development of the Sub-Precinct and has informed the proposed planning framework of the SSP Study.

The urban design framework for the Paint Shop Sub-Precinct comprises:

- Approximately 1.4 hectares of publicly accessible open space, comprising:
  - A public square – a 7,910 square metre public square fronting Wilson St;
  - An eastern park – a 3,871 square metre park located adjacent to the Chief Mechanical Engineer's Building and the new eastern entry from Platform 1 of the Redfern station; and
  - Traverser No1 - a 2,525 square metre public square edged by Carriageworks and the Paint Shop.
- Retention of over 90% of existing high value trees.
- An overall greening coverage of 40% of the Sub-Precinct.
- A maximum of 142,650 square metre gross floor area (GFA) comprising:
  - between 103,700 - 109,550 square metres of GFA for employment and community facility floor space (minimum 2,500 square metres). This will support approximately 6,200 direct jobs on the site across numerous industries including the innovation, commercial and creative sectors.
  - between 33,100 - 38,950 square metres of GFA for residential accommodation, providing for between 381 - 449 new homes (including 15% for the purpose of affordable housing).
- New active transport infrastructure and routes to better connect the Paint Shop Sub-Precinct with other parts of Tech Central and the surrounding localities.
- Direct pedestrian access to the new Southern Concourse at Redfern Station
- Residential parking rates, comprising:
  - Studio at 0.1 per dwelling
  - 1 Bed at 0.3 per dwelling
  - 2 Bed at 0.7 per dwelling
  - 3 Bed at 1.0 per dwelling
- Non-residential car parking spaces (including disabled and car share) are to be provided at a rate of 1 space per 700 square meters of GFA.
- 66 car spaces are designated for Sydney Trains maintenance and operational use.

The key features of the Urban Design Framework, include:

- The creation of a new public square with direct pedestrian access from Wilson Street to provide a new social and urban hub to promote outdoor gatherings that will accommodate break out spaces and a pavilion structure.
- An eastern park with direct access from Redfern station and Little Eveleigh Street, which will provide a high amenity public space with good sunlight access, comfortable wind conditions and community character.

- Upgraded spatial quality of the Traverser No1 yard, retaining the heritage setting and incorporating complementary uses and good access along Wilson Street to serve as a cultural linkage between Carriageworks and the Paint Shop Building.
- The establishment of an east-west pedestrian thoroughfare with new public domain and pedestrian links.
- A range of Water Sensitive Urban Design (WSUD) features.
- Activated ground level frontages with commercial, retail, food and beverage and community and cultural uses.
- Adaptive reuse of heritage buildings for employment, cultural and community uses.
- New buildings for the Sub-Precinct, including:
    - Commercial buildings along the rail corridor that range between 3 and 26 occupied storeys;
    - Mixed use buildings along the rail corridor, comprising a three-storey non-residential podium with residential towers ranging between 18 to 28 occupied storeys;
    - Mixed use buildings (commercial and residential uses) along Wilson Street with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 9 occupied storeys that are set back from the street wall alignment;
    - A commercial building on the corner of Wilson Street and Traverser No.1 with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 8 occupied storeys that are set back from the street wall alignment. There is flexibility to allow this building to transition to a mixed-use building with active uses at ground level and residential uses above; and
    - Potential options for an addition to the Paint Shop Building comprising of commercial uses. These options (all providing for the same GFA) include:
        - A 5-storey commercial addition to the Paint Shop Building with a 3m vertical clearance, with the adjacent development site to the east comprising a standalone 3-storey commercial building (represented in Figure 3.2);
        - A 3-storey commercial addition to the Paint Shop Building with a 3m vertical clearance which extends and connects to the commercial building on the adjacent development site to the east; and
        - No addition to the Paint Shop Building, with the adjacent development site to the east comprising a standalone 12-storey commercial building.
- Commitment to a 5 Star Green Star Communities rating, with minimum 5 Star Green Star Buildings rating.
- All proposed buildings are below the Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) to ensure Sydney Airport operations remain unaffected.

The proposed land allocation for the Paint Shop Sub-Precinct is described in Table 12 below.

Table 12 – Breakdown of allocation of land with Paint Shop Sub-Precinct

Land Allocation	Existing	Proposed
Developed Area	15,723 sqm / 30% of total site area	20,824 sqm / 40% of total site area
Public Open Space	Area not publicly accessible	14,306 sqm / 28% of total site area
Other Public Domain Areas (including streets, shared zones, pedestrian paths and vehicular zones)	Area not publicly accessible	15,149 sqm / 29% (Excludes privately accessible public links and private spaces approx. 3% of total site area)

The Indicative Concept Proposal for the Paint Shop sub-precinct is illustrated in Figures 3.1 and 3.2 below.

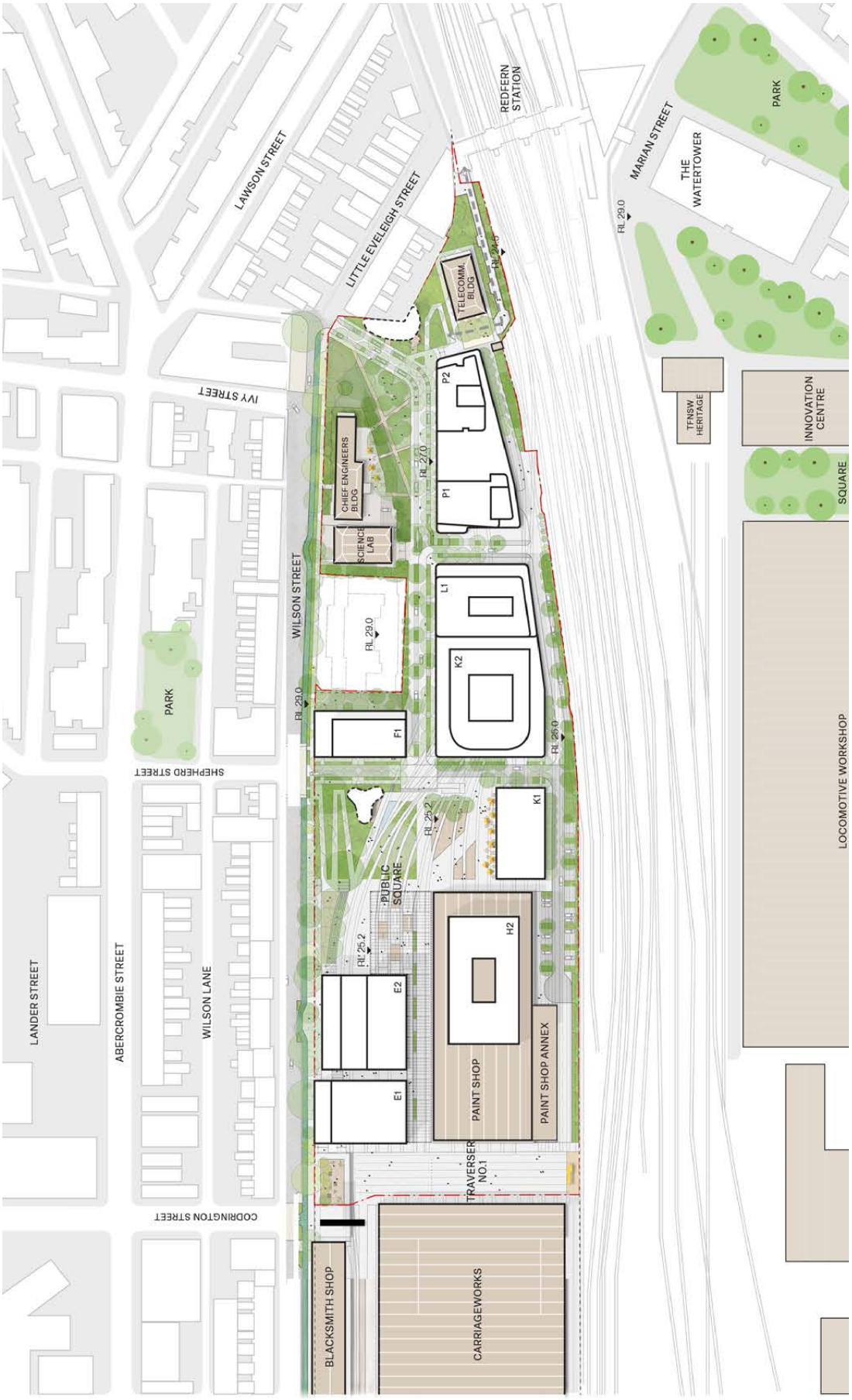

Figure 3.1 – Indicative Concept Proposal (Source: Bates Smart)

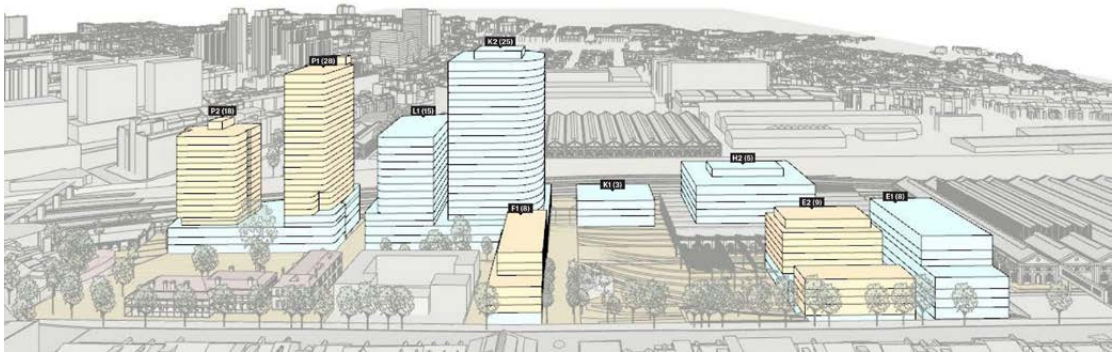

Figure 3.2 – Indicative Concept Proposal - massing aerial viewed from Wilson Street (Source: Bates Smart)

Figure 3.3 – Computer generated image of the proposed Little Eveleigh upgrade already proposed and providing a shared pedestrian link between the precinct and Redfern Station (Source: NSW DPIE)

Figure 3.4 – Computer generated section of the proposal, demonstrating how the existing trees can be retained and proposed landscape treatments will aim to screen and soften the proposed built forms and provide extensive canopy cover and greening around the existing CME building in the east of the Sub-Precinct. (Source: Turf Studio/ Bates Smart)

Figure 3.5 – Computer generated image of the proposal, demonstrating how the central spine will work to include the heritage components of the existing Paint Shop building annex structure overhead (Source: Turf Studio)

Figure 3.6 – Computer generated image of the eastern park proposal, demonstrating how the central spine will work to include the heritage and garden curtilage components of the existing CME building, the introduction of a new open space area. Integration of tree planting will aim to emphasise the central spine and contribute to the proposed urban canopy coverage (Source: Turf Studio)

Figure 3.7 – Computer generated image of the proposal, demonstrating how the Paint Shop square includes significant canopy cover to the Wilson Street frontage while respecting the heritage components and curtilage of the existing Paint Shop building (Source: Turf Studio)

3.2 Proposed Development Staging

The proposed development is proposed to be staged over several years. The following main stages have been identified and are illustrated graphically below:

- Stage 1 - CME and Science Building revitalisation
- Stage 2 - Wilson Street development
- Stage 3 - Eastern end and adjoining shared zones and public parks
- Stage 4 - Paint Shop and adjoining public squares and streets
- Stage 5 - Remaining building infill development to complete overall delivery of the project

The realisation of the proposal is likely to take at least 8-10 years to complete. It is, therefore, anticipated and expected that detailed and updated site specific assessments of existing trees will be carried out and lodged with all detailed and site specific development applications within the Sub-Precinct. Trees are dynamic and living organisms and changes in their condition over time or relatively small changes to the proposed layouts or methods of construction may have significantly lesser or greater impacts on individual trees.

It is also important to note that the removal of the trees and the establishment of the new green infrastructure will occur over a somewhat extended time frame. Not all the proposed removals will occur at one time. Trees listed for removal in later stages may remain in place for some years. Likewise, new planting will be undertaken progressively, so newly installed trees and other greening should be starting to mature and provide replacement canopy, aesthetic and other ecosystem services by the time later stage trees are being removed.

Figure 3.8 – Indicative Development Staging Process - Stage 1 Staging CME - Revitalise Existing heritage buildings on Wilson Street. (Source: Bates Smart/Transport)

Figure 3.9 – Indicative Development Staging Process - Stage 2. Wilson Street new developments adjacent Paint Shop. (Source: Bates Smart/Transport)

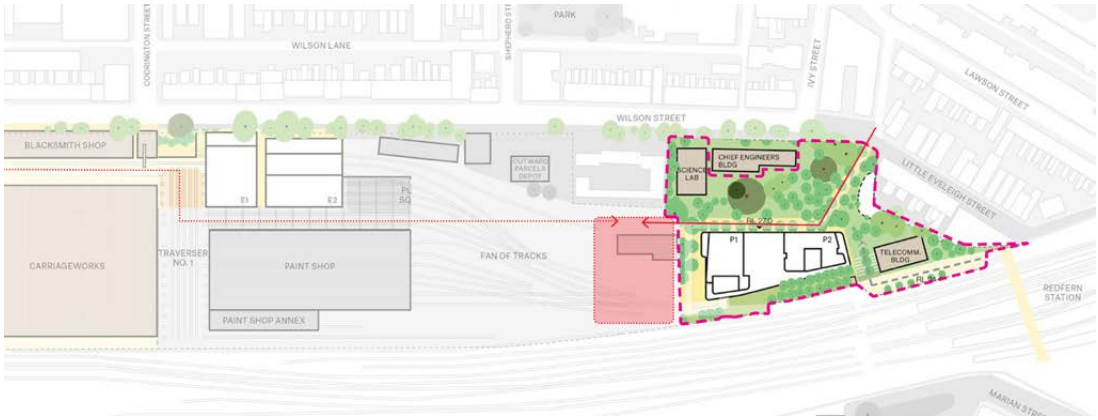

Figure 3.10 – Indicative Development Staging Process - Stage 3. Eastern end - Developments along rail edge, complete community park, establish connection to platform 1. (Source: Bates Smart/Transport)

Figure 3.11 – Indicative Development Staging Process - Stage 4. Paint Shop - Completing Central square and main access road. (Source: Bates Smart/Transport)

Figure 3.12 – Indicative Development Staging Process - Stage 5. Complete Masterplan - Last developments completing the overall development. (Source: Bates Smart/Transport)

3.3 Consideration of Proposal Impacts

At this conceptual phase of the development, the required information and level of detail that is required to fully assess the impacts such as embodied emissions associated with construction and the ultimate use of the development is not yet available. Likewise, it is not possible within the scope of this report to definitively assess the impacts of the total proposal on climate change, heat impacts and community health needs as this is an enormously complex assessment that is reliant on numerous factors. By far the greatest impacts are likely to be generated by the buildings themselves, their construction and their future operation and uses. For example climate change impacts are heavily reliant on a number of interrelated and variable factors including:-

- How the buildings are ultimately built and constructed;
- The amount and type of materials used in the construction of the building and final landscaping;
- The energy use and efficiency of the future buildings; and
- The successful provision, or not, of an integrated water cycle management strategy.

To more fully address this study requirement, we refer the relevant authorities to the Environmental Sustainability Report prepared by Arup and their identified opportunities and recommendations regarding decarbonisation of building materials and construction and potential energy sources, reduced transport emissions and integrated waste strategies. However, some general comments on the impacts of the development on climate change, reducing embodied emissions, urban heat island effects and community wellbeing, based on the currently known and proposed designs, are made below.

- The current design indicates the retention or re-purposing of a large number of existing buildings and structures. Retaining, refitting, or re-purposing existing structures greatly reduces the embodied emissions associated with construction.
- Currently the site has very low canopy cover and extensive impermeable surfaces. There is also very little observable and active management or treatment of existing stormwater. The proposal seeks to increase permeable surfaces and greatly increase urban canopy cover using more appropriate and long lived species of trees. This has the potential to partially offset carbon emissions used during the precincts construction and will also actively contribute to a reduction of urban heating.
- The significant, larger and more important existing trees are being retained, maintaining the stored carbon and instantly providing for urban canopy cover within portions of the site.
- There is implementation of increased percentages of green cover through the new lawn areas, gardens, rain gardens, green roofs and tree canopy cover that will help to moderate urban heat, shade buildings and pavements and generally reduce the reliance on energy intensive cooling for many of the residential and commercial tenancies.
- There is substantial potential for co-location of photovoltaic panels with green roofs, which has the ability to improve their efficiencies and increase the diversity of plant species that can be used on roof gardens

Figure 3.13 - Currently the site is a neglected and largely inaccessible industrial landscape with a variety of degraded landscapes and buildings. Although there is some 'green cover', the vast majority of this is simply weed and grass growth amongst the degrading and over the otherwise impermeable pavements. The existing 'canopy coverage' with the site itself is less than 7% (Photo: Arterra)

Currently the site is a relatively neglected and largely inaccessible industrial landscape with a variety of degraded landscapes and buildings. In its present state, it provides very little contribution to urban greening or community health and well-being. The proposal will see significant portions of the site returned to a far more positive community, environmental and recreational use, with accessible and active streets, community accessible parks and open spaces and, arguably, much improved urban greening.

Although there is some loss of existing trees, the vast majority of these are very low quality trees and primarily weed species. All 'high' value trees identified in the precinct are being retained and over 90% of moderate value trees are being retained.

The current 'green cover' of the site measures at approximately 26%. This, however, is heavily skewed by weeds and grass growth that is occurring on the now disused portions of the site and particularly within the extensive area of the fan of tracks in the middle of the site. This appears to be opportunistic growth amongst degraded pavements and the building up of wind blown and water derived sediment deposits. These are often occurring over otherwise impervious pavements and heavily compacted subgrades. (Refer to figure 3.13 and 3.14)

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In respect to the green infrastructure and the proposed landscape embellishments, it is the author's opinion, that the proposal will have a net positive effect, compared to the existing situation.

- There will be a **net increase in urban canopy cover** from **10%** to at least **25%.**
- There will be a **net green cover increase** across the site from less than **26%** to at least **40%.**
- 100% of 'High' value trees are planned to be retained.
- > 90% of 'Moderate' value trees are retained.
- The trees to be removed are to be replaced at an **offset ratio of 3:1** trees for every tree removed. (3 trees will be planted for each tree removed).
- The replacement tree strategy currently proposes the incorporation of substantial numbers of endemic trees and understorey plants that should see a **net improvement in biodiversity** and reduction in harmful weed sources .
- Subject to final detailed design outcomes around green roofs and rain gardens and improved deep soil zones and other WSUD initiatives, the proposal should see **an improvement in water quality and reduction in stormwater** leaving the site.
- There is a significant potential, as part of the future detailed design, for the adoption of an **integrated water management strategy** for the precinct to provide improved opportunities for open space irrigation and the improved sustainability of public green infrastructure through passive irrigation, rainwater, stormwater and greywater harvesting.

If urban canopy coverage approaches **25-30%** there is also currently clear evidence, from recent studies, that the proposal should result in **measurable improvements in community health** outcomes, particularly for those that live and work in close vicinity.

Figure 3.14 - Currently the site is a neglected and largely inaccessible industrial landscape with a variety of degraded landscapes and buildings. Although there is some 'green cover', the vast majority of this is simply weed and grass growth. At present the site is generally not accessible, provides little environmental benefits and provides virtually no community health benefits (Photo: Arterra)

3.4 Sub Precinct Sustainability Initiatives

The NSW Government and the Greater Sydney Commission both aspire NSW and metropolitan Sydney to achieving net-zero emissions by 2050 and to help NSW become more resilient to a changing climate. Achieving carbon neutrality largely relies on our government and community's adoption of renewable energy sources, changes in building design and construction, changes to transport infrastructure and fossil fuel use.

While it is essential we reduce emissions and build better buildings and deal with waste, it is also advantageous to capture and sequester the carbon already in the atmosphere. Studies have shown urban trees definitely contribute to this process, and young and rapidly growing trees can capture carbon at higher rates than more mature and slower-growing counterparts. (Coutts, C. and Hahn M. 2015)

Further reference should be made directly to the Environmental Sustainability report by Arup for information regarding the sustainability proposals and targets for the development. We note that the Sub-Precinct is to achieve various Green Star ratings, as developed by the Green Building Council of Australia. 'Green Star – Communities' assesses the planning, design and construction of large scale development projects at a precinct, neighbourhood and community scale. It provides a rigorous and holistic rating across five primary impact categories. These categories are:

1. Governance
2. Liveability
3. Economic prosperity
4. Environment
5. Innovation

The urban forest and greening study aligns with many of the above rating criteria and targets outlined. The Liveability category encourages the development of healthy and active lifestyles, and rewards communities that have a high level of amenity, activity, and inclusiveness. The Environment category aims to reduce the impact of urban development on ecosystems. It encourages resource management and efficiency by promoting infrastructure, transport, and buildings, with reduced ecological footprints. The Environment category therefore

Figure 3.15 – Trees have a great deal of influence over the environmental performance of an urban area. Good canopy cover, particularly over streets and fronting buildings can help mitigate urban heat island affects, lower ambient temperatures by several degrees during heat waves and reduce the demands for air conditioning. The sensible use of deciduous species in key locations also allows solar access for sunlight and warmth during cooler months. (Photo: Arterra)

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seeks to reduce the impacts of projects on land, water, and the atmosphere. Although metrics of urban forestry, trees and greening are not specifically outlined or assessed in the current 'Green Star' rating system, the urban forest initiatives outlined within this study do support the requirements of the 'Green Star' rating system. The way that this will be achieved includes:

- Increasing canopy coverage wherever possible to reduce greenhouse gas emissions by shading buildings, cars and pavements.
- Mitigating urban heat island effects by reducing ambient temperatures at ground level and improved cooling during extreme heatwave through evapotranspiration.
- Creating more comfortable and walkable streetscapes, thereby promoting liveability and activity.
- Utilising trees to capture and reduce gaseous and particulate pollutants and intercept and ameliorate stormwater flows.
- Improving biodiversity by advocating an appropriate and diverse mix of tree species throughout the wider estate and utilising, where sensible, endemic tree species that provide beneficial habitat and linkages.
- Adapting to climate change by recognising that a gradual change and adoption of potential species that may be better suited to warmer climates and increased heatwave extremes is needed. Also by promoting the use of water sensitive design strategies that may passively irrigate trees wherever possible to allow them to better deal with extremes and drought conditions.

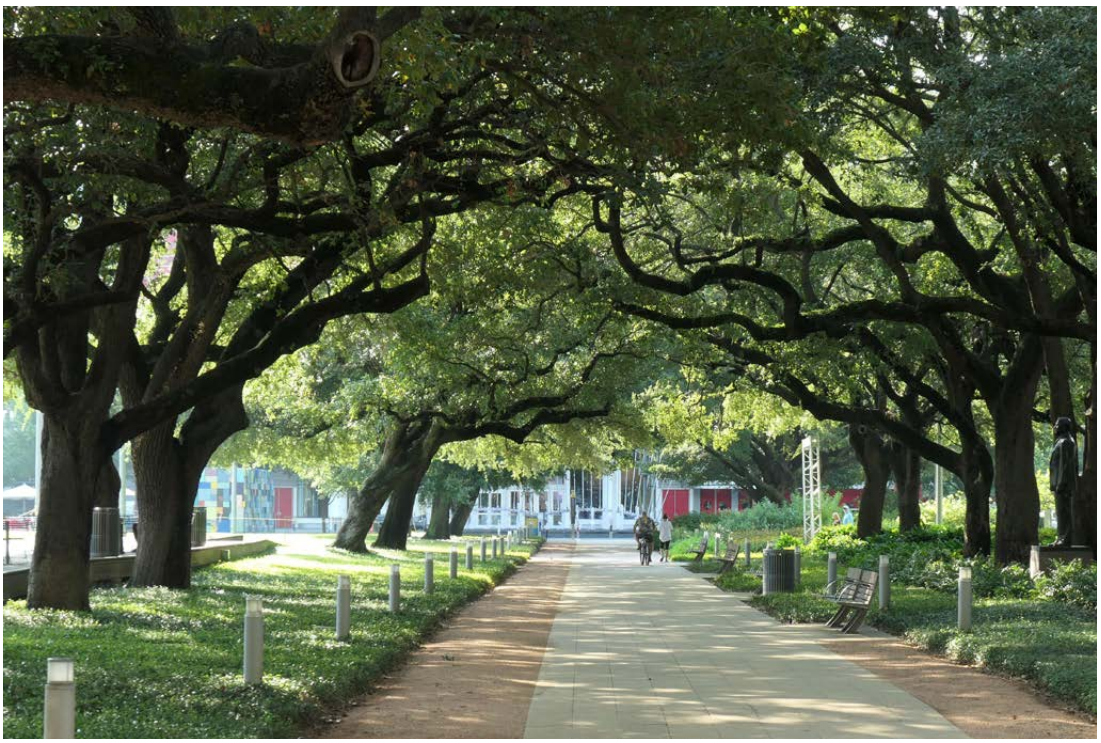

Figure 3.16 – Prioritising tree planting within all public areas, streets and laneways establishes a cooler and more comfortable environment to be enjoyed by the community and can provide distinct landmarks and gateways to enhance placemaking. (Photo: Arterra)

3.5 Place Making Initiatives

At the heart of the Indicative Concept Plan is the desire to create a resilient and connected community. As the Sub-Precinct, and wider Precinct grows, 'place making' initiatives must amplify the community voice and support networks between people. During the consideration of the current urban forest and greening study several key place making principles have been woven into the strategies and objectives.

Particularly relevant to the urban forest and greening study, some place making initiatives include:

- Supporting the connections to North Eveleigh Station and Redfern Station to establish the Sub-Precinct as a destination and as a gateway to the surrounding neighbourhood.
- Embedding educational, recreational, indigenous and productive programs into the public domain.
- Providing a rich tapestry of inclusive and informal gathering spaces.
- Delivering a wide range of outdoor spaces and destinations which support a highly walkable place.
- Making nature a central theme to intensify the feeling and perception of greenery within the urban setting.
- Creating an engaging ground floor interface for pedestrian delight.

The ways the green infrastructure and the urban forest will therefore contribute to the above initiatives include:

- Retaining and protecting a number of the existing high and moderate value trees.
- Prioritising new tree planting within most public areas, streets and laneways to achieve ultimate canopy coverage of the Sub-Precinct.
- Integrating the tree planting together with the urban fabric and the retail/commercial needs.
- Using trees to help create comfort and shade, in a safe and beautiful way.
- Using unique spaces and edges to create special areas for diverse planting and signature tree planting to promote and foster social gathering.
- Advocating signature and relatively unique trees to highlight key activity nodes.
- Promoting the use of the podium levels of new buildings for tree planting, green roofs, green walls and potential productive gardens and community orchards.
- Promoting innovative greening strategies to maximise greening opportunities that are distributed evenly across the Sub-Precinct and are accessible.
- Improving the walkability and liveability of the Sub-Precinct through tree planting, installation of green roofs, implementation of ground level planting and utilising water in the landscape to promote urban cooling and increase comfort in the landscape.
- Reducing the level of absorbed and radiated heat by reducing the amount of paved and hard surfaces.
- Celebrating water by using passive irrigation, the storage and re-use of water to support vegetation and facilitate the cooling effects of evapotranspiration.
- Utilising trees and the urban forest as a support and focus for temporary or permanent artistic and sculptural displays (in a non-injurious way) and promoting understanding and appreciation for the urban forest via community tours and community events.

3.6 Canopy Cover - Benchmarking

Many local governments and international cities are increasingly recognising the importance of urban greening and urban canopy coverage. They are commonly setting targets within their government policies to achieve particular coverage targets within their urban setting. For example:

- Sydney City are now aiming to increase overall **green cover to 40%** across the local area, which includes targeting **an averaged 27% tree canopy cover across the LGA by 2050**.
- Greener Places Strategy includes the following canopy cover targets for wider NSW
  - 40% canopy cover target across greater Sydney by 2036
  - >15% canopy cover in CBD areas
  - **>25% in urban residential** (medium to high density) and light commercial areas
  - >40% in suburban areas.
- Melbourne City is aiming to increase the public realm canopy cover from 22% (2012) to **40% by 2040.**
- Seattle City in the US has established a target in 2007 to reach **30% by 2037**. In 2016 a canopy study measured the coverage at 28%.
- Portland City in the US, back in 2007, has established a target of **33.3% tree canopy coverage citywide by 2035**.
- Toronto City in Canada has proposed to significantly **expand its urban tree canopy cover to between 30-40%**.

In addition to this, leading and current Australian research indicates there is a **need to provide 30-40% canopy cover** to optimise heat mitigation and obtain the greatest community health benefits. A 2019 Australian study 'Association of Urban Green Space with Mental Health and General Health Among Adults in Australia' by Professor Astell-Burt and Dr Feng found that in neighbourhoods with a tree canopy cover of 30% or more, adults had:

- 31% lower odds of psychological distress
- 31% lower odds of developing diabetes
- 21% lower odds of developing cardiovascular disease
- 21% lower odds of developing cardio hypertension
- 33% lower odds of rating their general health as fair or poor, over a six year period.

Researchers at the Massachusetts Institute of Technology (MIT), in collaboration with the World Economic Forum, launched TREEPEDIA in 2016, which is a new platform that uses Google Street View data to measure and compare the green canopy in cities around the world. They have developed an innovative metric utilizing Google Street View (GSV) panoramas, called the 'Green View Index' by which cities can evaluate and compare green canopy coverage as viewed from street level perception. (Project by the MIT Senseable City Lab - http://senseable.mit.edu/treepedia accessed May 2018).

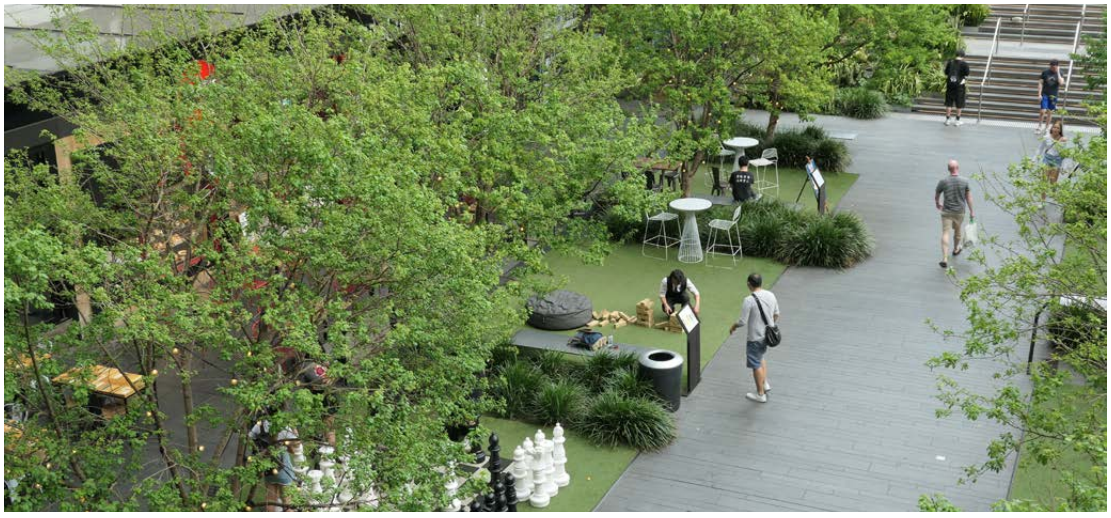

Figure 3.17 – Prioritising urban greening, and particularly tree planting has been shown in recent studies to provide numerous positive health benefits to the community. (Photo: Arterra)

The following graph displays where Sydney lies in terms of the Green View Index, as measured under the above system. It is important to note this measure is based on a street level assessment rather than actual plan view canopy coverage, so direct comparison to other measurements is not possible.

These City targets and leading research helps to provide a solid framework and target to work towards to provide the community with tangible outcomes. A target of at least 25 - 30% canopy cover aligns with most other local and international cities that have all recognised the benefits of urban greening. The currently measured canopy coverage of the wider North Eveleigh Precinct stands at 16%, with the Paint Shop Sub-Precinct measuring only 10.2%. This means the current Sub-Precinct is providing very little in canopy coverage to the area. Any longer term lack of canopy cover within the Paint Shop Sub-Precinct will likely have a commensurate flow on effect to the wider area and the city as a whole.

There appears to be good prospects for the proposed development within the Paint Shop Sub-Precinct to positively increase and contribute to a net increase in greening and achieve at least 25% canopy cover.

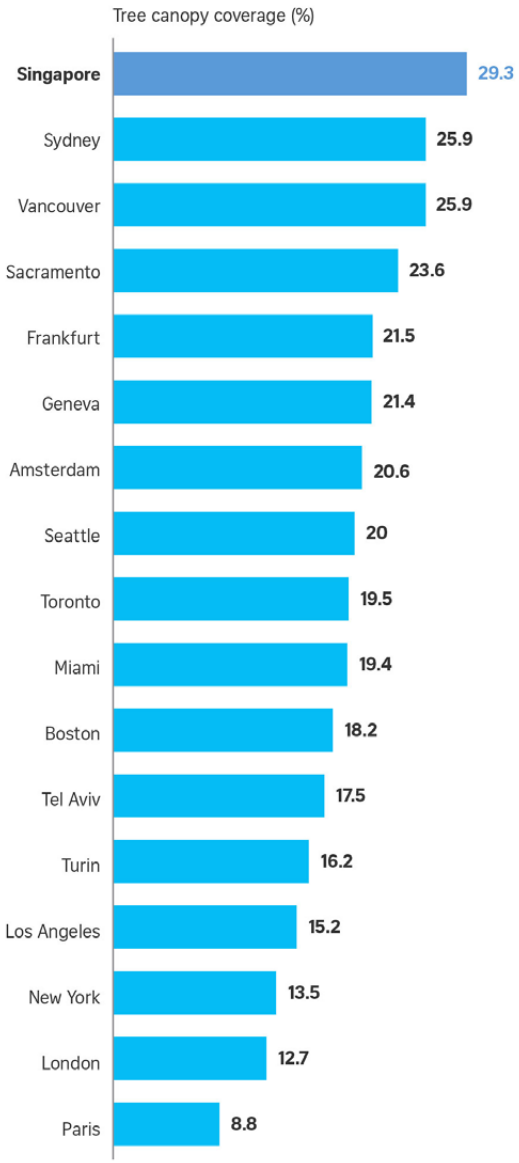

Figure 3.18 – A graph of the Green View Index canopy coverage score as presented in Singapore's Straits Times in 2017. Sydney is well placed in comparison to other global cities. (Source: Treepedia and Straits Times Graphics. https://www.straitstimes.com/singapore/environment/singapore-tops-list-of-17-cities-with-highest-greenery-density -published 22 February 2017).

4. IMPLEMENTATION OF THE URBAN FOREST AND GREENING STRATEGIES

4.1 Overview

Research has consistently shown that medium to large trees provide the greatest ecological and community benefits, in comparison to small trees. They create more canopy spread and shading benefits, absorption of more gaseous pollutants, stormwater interception, lower levels of tree vandalism, and achieve higher canopy clearances. For example, one very large tree (such as *Ficus macrophylla* – Morton Bay Fig) with a canopy diameter of 25 metre, can nominally achieve a canopy coverage of 490 square metres. One would need to plant at least 17 smaller trees to achieve the same coverage. For example a *Tristaniopsis laurina* – Water Gum, with a canopy diameter of 6 metre, achieves only a nominal 28 square metre canopy coverage (and these trees won't achieve the same wind mitigation, shading or stormwater interception).

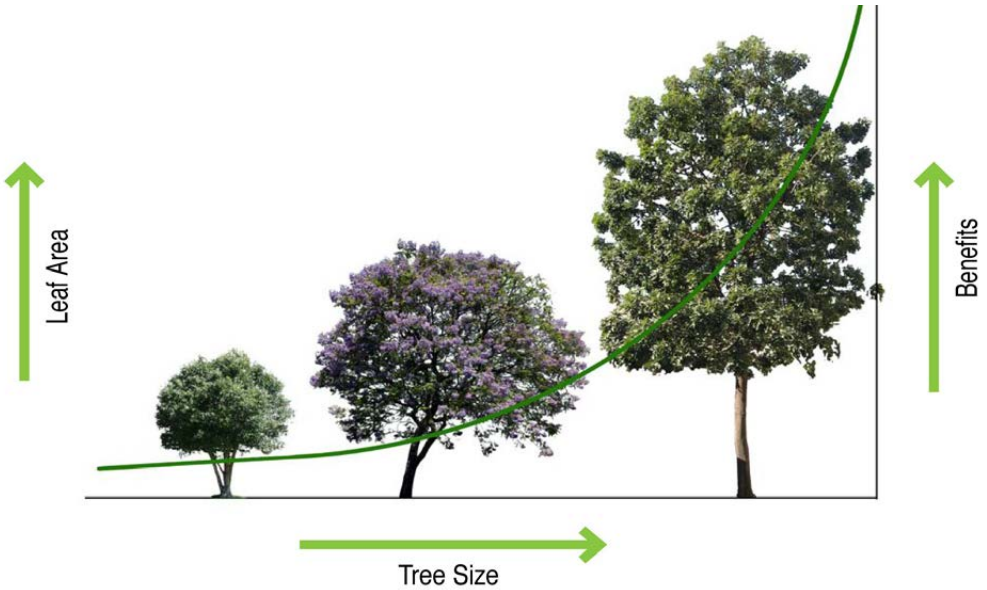

Figure 4.1 - Tree size does matter - the benefits of trees increase exponentially with size and increases in leaf area. (Adapted from Urban Tree Alliance http://www.urbantreealliance.org/why-trees/ accessed 12/7/2012)

Medium and larger growing trees are also commonly longer lived than smaller trees. Large trees, however, do require larger soil volumes and more physical space above and below ground than small trees, which needs to be designed and factored into any new planting. However, the ultimate benefits to the community are usually exponentially increased over their lifetime. Using the paradigm of 'right tree for the right location', a medium to large tree should only be specified and planted for an area where there is obviously sufficient space, and the growing conditions are suitable for the foreseeable life span of the tree. Smaller trees will also have a place in the urban forest for areas where physical space, overhead infrastructure, parking and traffic restrictions or exposure (ie. roof tops) present overriding factors.

The holistic planning of the Paint Shop Sub-Precinct provides opportunities and benefits for the creation of sustainable and valuable green infrastructure. As part of this project there is a rare opportunity within a major inner urban area to implement urban forestry and greening initiatives on a larger scale. This section of the document outlines the strategies and targets for the Sub-Precinct required to:

- Retain the more important and suitable existing trees.
- Maximise and create opportunities for new and replacement trees.
- Maximise general green coverage across the Sub-Precinct, utilising increased ground level greening as well as other on-structure planting opportunities such as green roofs and green facades.
- Achieve the objectives of the wider Precinct and other relevant planning documents .
- Plan for, and plant trees with the outcome and maximum sustainability and integration within the urban fabric in mind - ensuring the 'Right Tree for the Right Place' paradigm. This will minimise pruning and other future interventions required, maximise natural root development, and provide trees with improved health and resilience to droughts, storms and climate change impacts. This will also minimise costs and resource inputs and maximise the long term benefits.

Figure 4.2 – When properly considered, trees and green cover can be valuable contributors to urban ecosystem services with minimal ongoing resource inputs and minimal impacts to other hard infrastructure and human wellbeing. (Photo: Arterra)

4.2 Achieving The Ultimate Greening and Canopy Coverage Targets

There are significant opportunities to protect and enhance the existing urban forest. Research has indicated that tree canopy is often far more important than other forms of greening. The proposed Master Plan comprises:

- Retention of 100% of existing high value trees and >90% of the moderate value trees and substantial planting of new trees to supplement and enhance the urban greening outcomes.
- Substantial implementation of new lawns, raingardens, green roofs and gardens to achieve the Sub-Precinct's overall increase in 'green cover' within the constraints of a heavily used urban precinct and other heritage constraints.
- Coverage of substantial areas of the Sub-Precinct with both existing and supplementary tree canopy.
- Coverage of approximately 50% of the new roofs or podium levels with greenery, however this does assume excluding the existing heritage buildings.

Key features of the Concept Proposal includes:

- Creation of a pedestrian priority precinct with new open spaces and a hierarchy of roads, lanes and pedestrian links.
- Introduction of a strong central east-west spine connecting Carriageworks, the proposed open space areas and other civic areas to Redfern Station, and beyond.
- A range of Water Sensitive Urban Design (WSUD) features.
- Retention and protection of the heritage items and, importantly, their industrial context.

The following diagrams illustrate some of the key urban forest and 'greening' approaches that have been specifically developed for this project.

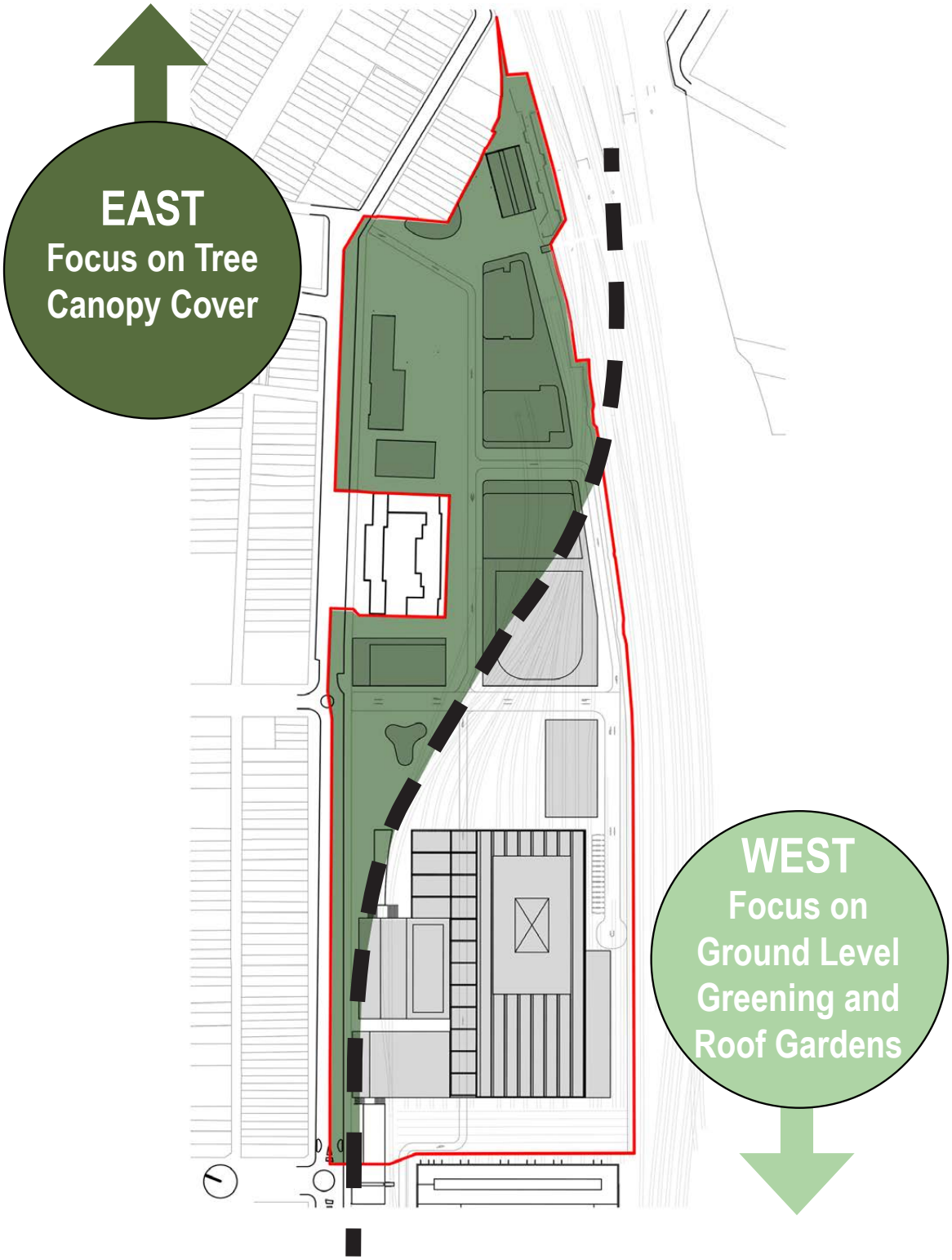

*Figure 4.3 – The Sub-Precinct shall generally be considered as two equal sized but distinct '**greening zones**', defined via the eastern edge of the broad sweeping line of the main 'Fan of Tracks'. The area generally north and east of the Fan of Tracks shall be focussed heavily on overall greening and particularly on the provision of urban tree canopy coverage. The area to the south and west of the Fan of Tracks shall be focussed on the provision of 'green cover' through provision of ground level greening, WSUD implementation and building roof gardens, with far less emphasis on trees. Using this philosophy the wider precinct targets can be met while protecting the industrial heritage values of the site. (Source: Arterra)*

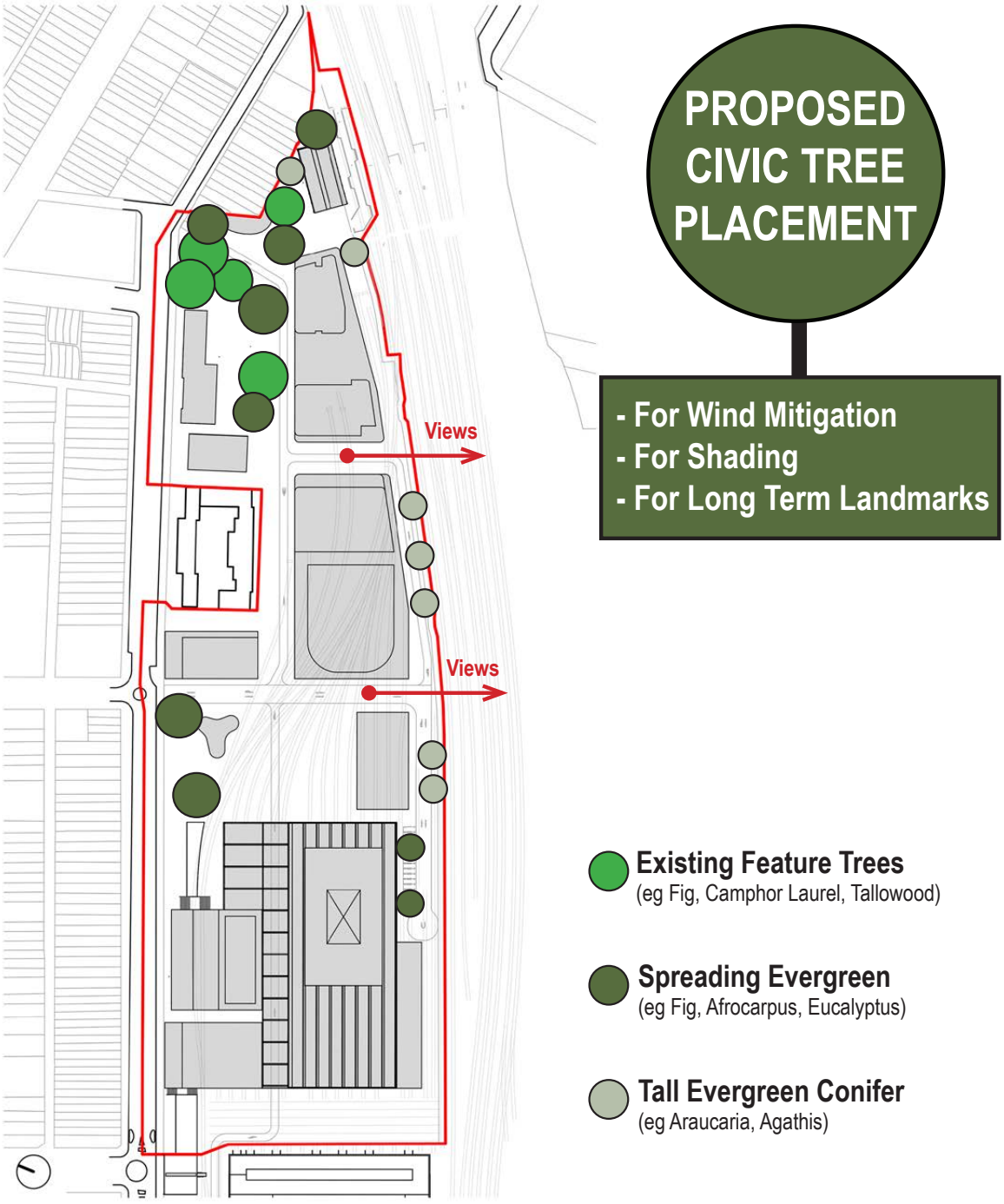

Figure 4.4 – Key to the strategy is to focus, where possible and feasible, on larger and civic scaled trees. Planting throughout the Precinct shall typically aim for a balance of tree sizes with certain proportions of trees, by number, to be achieved. A minimum of 10% civic (extra large trees) shall be planted. The above diagram shows the indicative locations of such tree planting. This will be subject to further detailed design and the ability to provide sufficient space and soil volumes. (Source: Arterra)

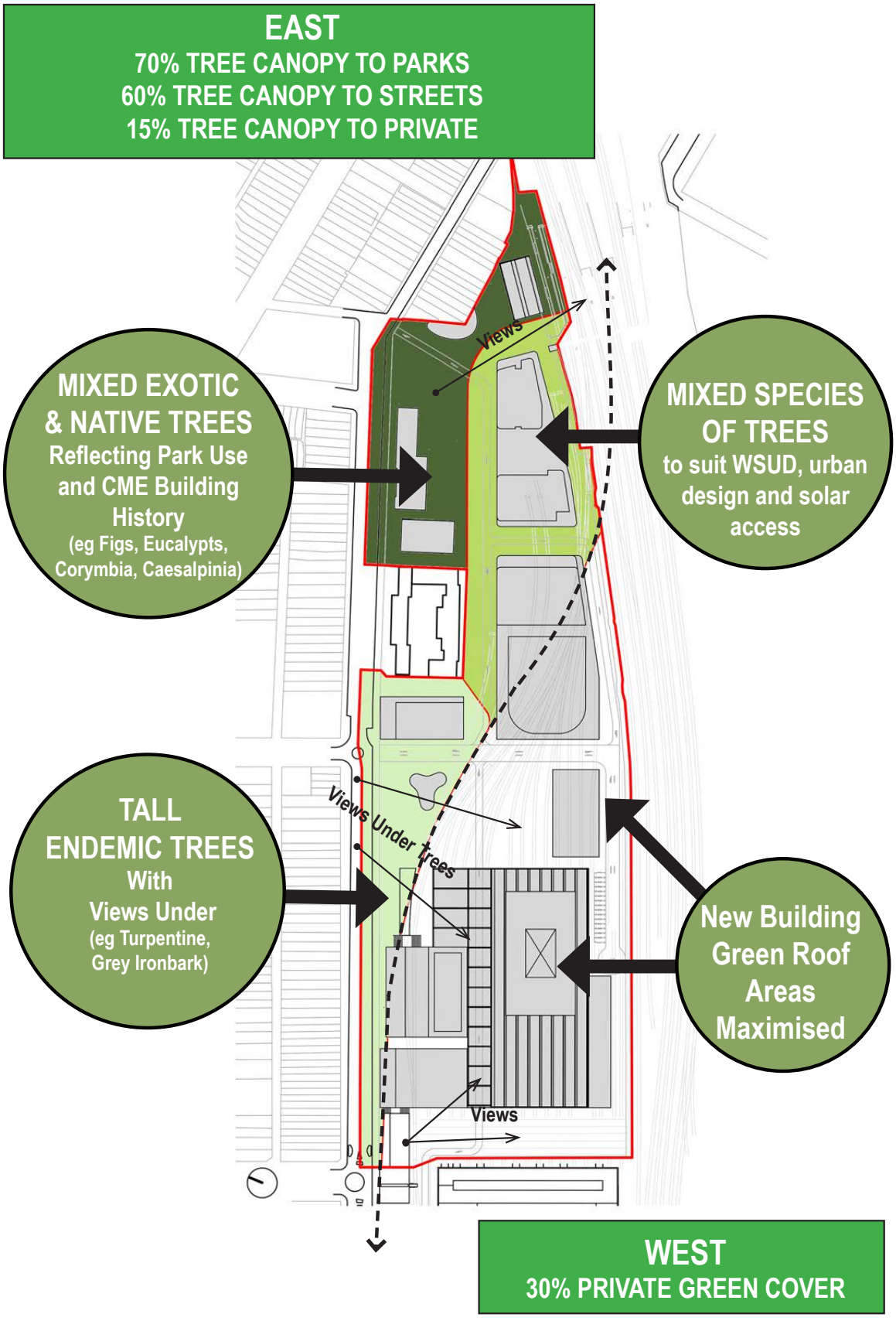

Figure 4.5 – The above diagram depicts the indicative location, critical function and proposed typical character of the urban forest and other greening to achieve the varied and often competing objectives of connection to country, heritage interpretation, sustainable tree planting, wind mitigation, ecology and human comfort . (Source: Arterra)

Figure 4.6 – Provision of green roofs and on-structure podium planting will be a vital component of the green infrastructure provision of the precinct. It can be combined with photovoltaic arrays and can greatly contribute to reduced urban heat and increased biodiversity and habitat values and connection to Country (Source: ZincoGreenRoofCo - Toronto [Pintrest])

The key greening targets and controls to be imposed for the Sub-Precinct are outlined below. The Sub-Precinct shall aim to achieve:

- A minimum of **40% 'green cover**' within the study area (this is 'all' greening including ground level planting, lawns, roof tops, podiums and tree canopy coverage, both existing and ultimate).
- A minimum of **25% 'tree canopy cover**', helping to contribute to wider CoS targets, while respecting the significant industrial heritage aspects of the Sub-Precinct.
- A minimum of **50% green roofs** and podium level planting to new buildings. All new buildings should be provided with some form of green roof or podium landscaping with a view to achieving a precinct wide average of 50% green roof coverage across the new buildings (For example, either 50% of the new buildings are provided with an extensive green roof or new buildings apply green roofs to at least 50% of their roof/podium areas). We note that there should be no mandated expectation to have green roofs installed on any existing heritage buildings.
- Protection of the most **significant existing trees** on the site and incorporate them as mature elements within the proposed landscapes. They can provide an important and instant framework for streets and for new parks and other green spaces. It will be important to recognise that mature trees require space around them to protect their roots and therefore it will be necessary to minimise buildings, level changes or service trenching through any areas retaining trees. It is possible to include suspended structures or walkways around existing trees, if they are very sensitively designed.
- Extensive **collection and re-use of a majority of rainwater** and a substantial component of the Sub-Precincts generated grey water to irrigate and sustain the expected green infrastructure, both public and private. Also direct surface water and runoff, wherever technically possible, towards existing and new trees and other green infrastructure to **passively irrigate** the plants in an ever-warming climate.

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- Clear guidance and promotion of **holistic street profile designs** to work trees in as one of the core elements of the design, not an after-thought. Space, both above and below ground, is the key. It is essential to consider final sizes of root plates, trunks, and canopy. The provision of suitable surface areas around the trees is often more critical than excessive soil depths.
- Achieve a mixture of trees from **at least 3 different botanic families** for all major internal streets and park planting.
- Achieve an **offset ratio of 3 to 1** for any existing trees removed. This being 3 trees to be replanted for each tree removed.
- Adequate **soil volumes** for all new tree planting with the minimum expectations clearly conveyed and promoted in the planning and design guideline outcomes.
- Planting of the majority of new trees **at ground level within natural soils** rather than relying too heavily on podium or on-structure planting. However, efforts should still be made to incorporate appropriate trees into the upper levels of built forms and podiums and on roof tops to further improve canopy coverage and increase connections to nature.
- Opportunities for **community orchard style planting** and implementation of urban agriculture in semi-public open spaces/ roof terraces/ podiums to provide urban food and community engagement with trees and greening.
- A **diverse range of species** into the final designs to increase resilience and diversity and achieve the commonly accepted targets of no more than:
    - 40% in any one family,
    - 30% in any one genus,
    - 10% in any one species.
- A **diversity of tree sizes** with a minimum of:
    - 10% civic scale trees (extra large in canopy and / or height)
    - 30-35% large trees
    - 50-55 % medium trees
    - And no more than 10% small trees,
- The use of larger **civic-scaled trees** such as Figs, Araucarias, Eucalypts and Agathis ahead of numerous small trees, in order to: -
    - maximise canopy cover versus resource allocation,
    - free up views to heritage buildings and facades,
    - provide vegetation that is more in scale with proposed and existing buildings,
    - provide landmarks at key visual points,
    - allow trees to be seen out of windows even many storeys above ground level.
- The use of species that currently **prosper in slightly warmer climates** to cater for climate change. (For example *Araucaria* sp, *Caesalpinia ferrea*, *Harpullia pendula*, *Tabebuia impetiginosa*) and look to use trees and plants that continue to transpire during extreme heat to maximise urban heat mitigation during heatwaves.
- Incorporation of **some deciduous trees and vines,** at appropriate locations, to provide for required winter solar access and human comfort during cooler months.
- The use of suitable trees for **wind amelioration**, understanding the most desirable forms, sizes, and densities of tree canopy in given locations. Larger trees with a denser canopy are usually more important than smaller trees or trees with very open canopies, in this regard.
- Use of appropriate **setback zones** near the buildings and street kerbs to allow planting of larger trees and always consider a trees ultimate size (including their trunk, root flares, and canopy spreads). **Don't over plant** for short-sighted or instant effects – as a general rule, allow the planned trees to mature with full and reasonably symmetrical canopies where possible. These trees are easier to manage in the long term, have better health outcomes and improved resilience and are able to be replaced when the time comes without leaving overly misshapen adjoining trees. It also gives the trees more ability to seek adequate resources rather than competing with each other.

4.3 Green Roofs and Podium Planting

The provision of **green roofs** and podium level planting will be key to achieving the ultimate Sub-Precinct's 'green cover' targets, and achieving numerous other sustainability outcomes. Virtually all new buildings should be provided with some form of green roof or podium landscaping. We do note, however, that there should be no mandated expectation to have green roofs on any existing heritage buildings.

For the wider city and the Sub-Precinct to achieve its 40% overall 'greening' target we need contribution to 'greening' to be incorporated and integral to all new buildings. Green roofs present a fantastic way to provide greenery to our urban environments and should be considered, in the same way solar panels are currently considered a normal building addition. Including plants and planting as an integral part of buildings is now well tested in many other cities and around the world. Roof and podium gardens have great potential to improve our urban environments and can be incorporated into higher density residential, mixed use and commercial buildings. They can also be achieved without taking up additional space because they can be within the building footprint.

Figure 4.7 – Provision of green roofs and on-structure podium planting will be a vital component of the green infrastructure provision of the Sub-Precinct. (Source: 'The Deck' - Phuket - [Pintrest])

Green roofs have a multitude of intrinsic benefits. They can:

- treat and store water and utilise captured stormwater.
- utilise captured and stored greywater from the building for their irrigation.
- provide cooling and improved insulation to reduce energy costs.
- greatly reduce urban heat island effects by removing surfaces that commonly absorb and then re-radiate heat at night.
- improve efficiency of photovoltaic panels by reducing the ambient temperatures around the panels when they are installed in concert with the surrounding greenery.
- bring significant gains in aesthetics and recreation, even for the neighbours who simply overlook them
- provide valuable locations for social and business activities.
- facilitate installation of community gardens, orchards and opportunities for urban food production
- provide significant biodiversity and homes for birds and insects,
- improve financial returns and increases in property values.

Green roofs also have a valuable contribution to managing urban stormwater. Stormwater runoff is often a significant problem in urban areas because the increased impermeable surfaces prevent natural infiltration and drainage. Stormwater can degrade natural stream environments, increase flood risk, and often puts pressure on aging drainage infrastructure. Green roofs therefore have a very valuable role to play in the Sub-Precincts integrated water management. Importantly, the performance of a green roof is site-specific and varies with local environmental conditions, the vegetation type and physical properties of substrates and layers used. Well designed, considered and implemented green roofs have the following water management benefits.

- Green roofs capture stormwater, reduce runoff volumes and delay the timing of peak flows.
- In similar Australian cities to Sydney, green roofs can retain between 86–92% of the annual stormwater runoff, depending on the specific rainfall patterns and intensity.
- Rainfall retention is enhanced by deeper substrates with greater water-holding capacity.
- Plant cover increases the rainfall retention capacity but there can be considerable variation in water uptake among different species.
- Substrate additives such as biochar can increase substrate water holding capacity and plant available water.

Green walls and facades are valuable initiatives but in comparison to urban tree planting and green roofs, they will generally have inferior overall benefits. Green walls, in particular, may not be the most desirable form of greening due to their increased irrigation and water use needs, relatively small footprints and often significant ongoing maintenance and resource costs. Their use is not discouraged, but must be well justified and targeted to specific urban design and green infrastructure needs. It is acknowledged that they still provide a valuable role in improving building shading, reducing heat build up and providing valuable aesthetic and habitat outcomes.

Each situation and microclimate needs to be considered on its merits. For instance, where space is limited and trees can't be installed, suitable vines growing over an otherwise blank wall or structure, with their roots well provided for at ground level within adequate natural soils, can be a particularly hardy and long-lived approach to greening the urban environment. This can often occur with minimised ongoing resource or maintenance commitments, if well considered.

Figure 4.8 – Provision of green walls, vines and green facades and other on-structure planting can be a vital component of the green infrastructure provision of the Sub-Precinct, and although visually impressive, must also be considered in relation to ultimate life cycle cost benefit analysis and resource allocation. (Photos : Arterra)

4.4 Green Links, Ecology and Open Space Integration

Trees and other greenery such as green roofs can provide shelter, roosting, food and other habitat resources for a range of fauna species. As outlined in Urban Ecology: Theory Policy and Practice in NSW, (Davies, et al., 2017) trees can benefit biodiversity in urban areas by making the matrix between surrounding core habitat patches or bushland more permeable and accessible to a range of species (Catterall et al., 1991). Trees are often described as keystone structures in highly modified urban landscapes because their ecological benefit, as defined by the value and ecosystem services they provide, is much greater than the land area they occupy. (Manning et al., 2009. Stragnoll et al., 2012)

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Consideration has been given to recommending trees, which expand on, and provide a connection between, open spaces or other vegetated areas, particularly those identified as priority habitat areas. Although native trees are preferable in this regard, it is important to note that exotic species also have habitat value. A mix of species is to be targeted throughout the entire precinct to achieve species diversity and other ecological and community outcomes.

Figure 4.9 – Key to the urban forest strategy is the use of suitable naturally endemic species such as Syncarpia glomulifera (left) (Turpentine), Eucalyptus paniculata (centre) (Grey Ironbark) and Angophora costata (right) (Smooth-barked Apple). These trees are proven urban performers and importantly with good architecture for providing large spreading canopies while maintaining appropriate clearances to streets and allowing views under to important heritage items. (Photos: Arterra)

4.5 Urban Greening - Resilience and Diversity

A key principle of sustainable green infrastructure is an appropriately diverse mix of species – which can be both native and exotic. This reduces the risk of loss should one species be susceptible to a new pest or disease. Diversity of tree species also provides benefits for biodiversity, aesthetic reasons, improves resilience and allows the provision of summer shading and winter sun. As we move into more uncertain times with regard to climate it is vital that any new tree planting considers proven past performances as well as potential resilience to the rigours of urban existence, potential changes to our climate and the resultant changing landscape of pests and diseases.

4.5.1 Climate Change Adaption

It is expected that potential water use restrictions and lower than average rainfalls that Sydney has previously periodically experienced will continue and potentially worsen into the longer term. Trees that are selected will need to be capable of surviving an average drought period, in reasonable condition, without reliance on potable water supplies. Passive irrigation through the use of Water Sensitive Urban Design will be designed into many of the new tree planting areas and will assist with additional water being available to trees in times of drought and during normal times. The use of some species of trees that thrive in slightly warmer climates and provide good shading such as Figs (*Ficus rubignosa, Ficus obliqua*), Pink Trumpet Tree (*Tabebuia impetiginosa*) Leopardwood (*Caesalpinina ferrea*), Tulipwood (*Harpullia pendula*) Kauri Pine (*Agathis robusta)* and *Araucaria sp.* would be very wise.

4.5.2 Pest and Disease Resilience

Overseas experience shows that widespread infestations of harmful pests and diseases can have devastating consequences on parts of our urban tree populations. Pertinent examples such as Ash Dieback in Europe, Emerald Ash Borer in the United States and Dutch Elm Disease have all but destroyed entire urban and native tree populations in those countries. The impacts of introduced pests and disease on our Australian urban forests is only likely to increase. This is due to a range of factors, such as increased temperatures (particularly over winter), storm events, greater or lower levels of rainfall events that may lead to stressed trees and the increase in international travel and trade with the risk of pests 'hitching a ride' to Sydney.

The recommended tree species for the Sub-Precinct shall be chosen to be generally resistant to currently known pests and disease. A diversity of species will be important in reducing any potential impact of any future widespread or devastating diseases impacting on any specific tree species. Where reasonable and practical to do so, a designed mixture of at **least 3 or more species from different botanic families** should be chosen for the major internal streets and primary open spaces to prevent the likelihood of any catastrophic canopy and greening loss due to climate change, droughts or pests.

4.5.3 Biodiversity

There is often much debate about the use of locally indigenous species, that is, species that originally grew within the area. Whilst locally indigenous species may be the most appropriate for local environmental conditions, the growing conditions within such urban environment are often now very different, particularly in a street situation. We must also consider the natural vegetation assemblage in this part of Sydney would have been open forests, woodlands and heath. Many of the species that grew in the Redfern North Eveleigh area naturally would not greatly contribute to the wider urban forest goals or relate well to the new built forms. Disturbed soil profiles, soil compaction, higher nutrient status, altered drainage patterns and paved surfaces are just a few of the problems with which urban trees must contend, and often endemic trees are not well placed to deal with these new environments.

When addressing this issue, a more useful division may be to view this point three ways:-

- Locally indigenous (or endemic) natives;
- Natives from other parts of wider Sydney or Australia;
- Exotic species from other areas of the world.

Local natives have the advantage of being climatically suited and live in some degree of equilibrium with natural pest organisms such as insects and fungi. Use of local natives promotes biodiversity and the creation of wildlife corridors, reinforces an 'Australian' sense of place, and can be very drought resistant.

Natives from other regions are less likely to be climatically adapted and they may enjoy freedom from some local pest organisms but if they become infested may succumb faster. Exotics may be almost completely free of native pests and diseases but run the risk of being devastated if others are accidentally introduced.

Regarding local, or at least NSW east-coast native species, and their suitability as inner urban street trees, the species that are best adapted are usually from drier rainforest and rainforest margins, particularly littoral rainforests where most trees are long lived, shade tolerant and shade producing. They also often continue to transpire during prolonged heat-waves, which provide important cooling effects through evapotranspiration. Some other species like many of our Eucalypt species tend to shut down their metabolic processes during the heat of the day and therefore make only modest contributions to mitigating the urban heat island affects. They are often not as successful as other species at providing worthwhile shading to pavements and parks.

The other highly successful species come from freshwater swamps and other areas that are poorly drained and aerated. Species from these environments are often highly resistant to root rot organisms and their root systems are well adapted to particularly adverse soil conditions.

Many of our more familiar natives such as Eucalypt trees are typically from the more open and drier vegetation communities. These species seem to perform poorly as street trees in inner urban areas due to their highly adapted and more specialised physiology. They are often adapted to soils of very low nutrient status with perfect drainage where rot organisms are at a disadvantage. Consequently these species are less tolerant to interference with their root systems, including compaction, waterlogging and construction damage. Depending on the design principles

sought, natives can also display a very variable habit or form which makes it difficult to establish and maintain a more consistently planted avenue, or achieve clearances to buildings and vehicles. They are also highly adapted to natural fire regimes and a consequence is they often 'bolt' in growth for brief periods when post-fire soil nutrients are temporarily higher. As this increased growth often persists in a high nutrient, fire free environment the tree can become structurally weak, highly elongated in form and their foliage and bark can become susceptible to attack by insects and other pests.

An important advantage of many exotics in the inner urban context is that they include numerous and useful deciduous trees, which provide greater sun access to the streets and residential apartments through the winter months. Some natives are deciduous but generally in spring or early summer (an inheritance of their monsoonal origins). The red and white cedars (*Toona ciliata, Melia azedarach*) are the closest native trees we have to winter deciduous but both suffer from severe pest problems under urban conditions and are often unreliable performers.

Many exotic deciduous species have the advantage of hundreds of years of selective breeding, which ensures quality stock. They are normally pollution tolerant, are more resilient to interference with roots or damage during construction works. The canopy shape and branch architecture of many exotics are able to tolerate the pruning and shaping required for urban infrastructure and street clearances.

In summary, both natives and exotics have their strengths and weaknesses for use as trees within the Sub-Precinct. The urban forest strategy aims to plant the right tree for the right location, for the right reasons and to continually strike an appropriate balance between the many competing objectives.

Figure 4.10 – The existing and proposed urban trees within the Sub Precinct will also provide some benefits to common urban wildlife. Where appropriate native or endemic species will be utilised, but even exotic species play an important part in providing roosting, nesting and feeding opportunities for a range of fauna. (Photo: Arterra)

4.6 Proposed Tree Species and General Urban Forest Composition

To address many of the key policy documents and the design outcomes and 'place making' directions for the Sub-Precinct, it is proposed to incorporate a relatively large range of species into the final designs. This will increase resilience and diversity and work towards the Sub-Precinct targets of no more than 40% in any one family, 30% in any one genus, and 10% in any one species. It will also help achieve a diversity of sizes with a target of less than 10% small trees, 50-55% medium trees, 30-35% large trees and 10% civic scale (extra large). Consideration should be given to incorporating species that currently prosper in slightly warmer climates to cater for climate change. (eg. *Tabebuia impetiginoisa, Caesalpinia ferrea, Harpullia pendula, Araucaria cunninghamii, A. heterophylla and Araucaria columnaris*) (refer Figure 4.11 and 4.13).

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It is also recommended that some exotic deciduous trees be strategically utilised for better solar access during cooler months, particularly to lower apartments and key retail areas (refer Figure 4.12). It will be necessary to carefully consider larger-scale introductions of species from the Myrtaceae family which may impact on meeting the target of <40% for any one family. Given the general dominance of this family throughout Australia, this may always be difficult to achieve and compromises of this target may inevitably be required.

The selection of proposed new tree species being used throughout the Precinct must consider many factors and must aim to be a balanced approach that considers:

- Basic suitability for dense urban area – fruiting, forms, failure risk, bark and leaf shedding, hardiness, proven performance and reliability in an urban context.
- Intrinsic contribution to canopy coverage - overall size and canopy spread and density.
- Known pest and disease tolerance.
- Tree management and maintenance requirements of both CoS and Transport.
- Spread of different sizes - preference for medium to large trees wherever they are possible and suitable to the positions provided.
- Overall forest composition and diversity.
- Tree architecture and aesthetics.
- Solar access – a mixture of deciduous and evergreen species will be required.
- Allergy and irritation considerations.
- Tolerance to wind and overshadowing from surrounding tall buildings.
- Commercial availability and nursery sizing and production practicality.

Figure 4.11 – Leopardwood (Caesalpinia ferrea) is a common and successful tree in the warmer parts of NSW and Qld. It has been successfully used as a street tree and grows well in Sydney in frost free areas. As part of our climate change adaptation it will be very sensible to look to species such as this to grace the streets and parks within the wider Redfern North Eveleigh Estate (Photo: Arterra)

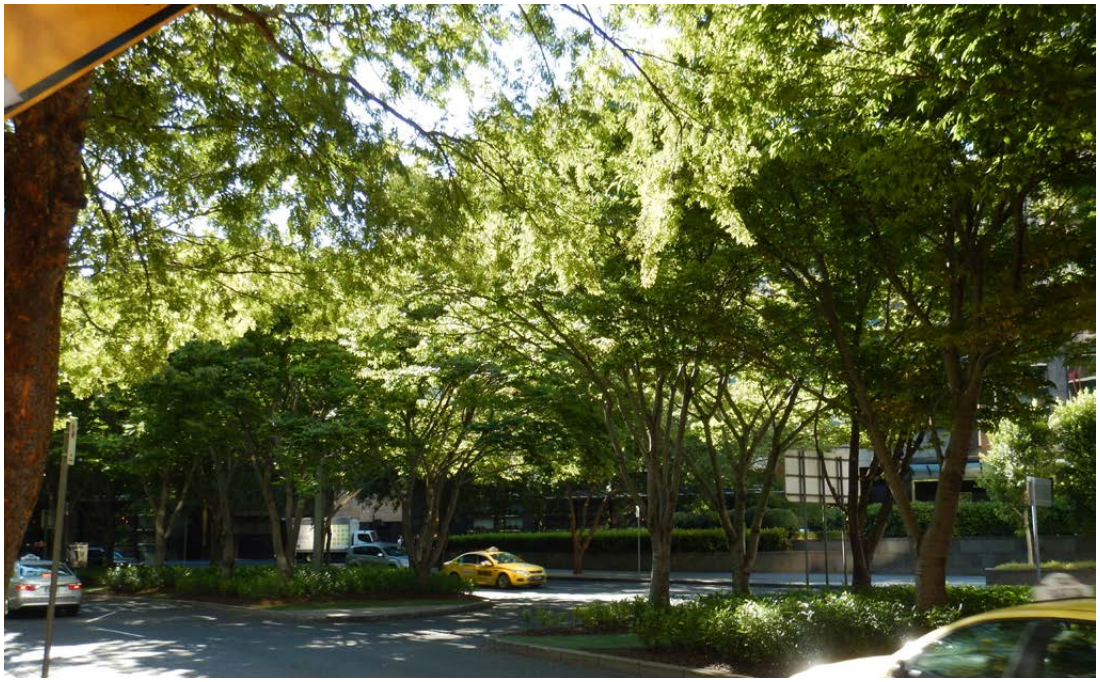

Figure 4.12 – Japanese Zelkova (Zelkova serrata 'Green Vase') is a common and successful tree in the numerous urban centres around the world including Sydney and Melbourne. It has been successfully used as a street trees and grows well in Sydney. This tree will provide many benefits with a similar form and character to the much over-used and more troublesome London Plane trees. (Photo: Arterra)

Figure 4.13 Species such as Araucaria cunninghamii (Hoop Pine) and Araucaria columnaris (New Caledonia Pine) grow well in Sydney. They will also be very tolerant of issues associated with climate change. They also provide trees that will be in keeping with the scale of the proposed tower developments. They will offer important screening and way-finding benefits. Their foliage will also be visible many storeys above the street and are highly resistent to winds. (Photo: Arterra)

In another practical way, some of the green infrastructure and chosen tree species should also help foster a greater understanding of indigenous culture and long held connections to the land and living things. The following outlines a list of some species of tree and also shrubs and other planting that should be considered within the detailed design of the urban forest for Redfern North Eveleigh. It may enable a greater Connection with Country and foster a greater appreciation of indigenous cultures and the past and ongoing uses of our native plants and animals. It also expands on the concepts of urban agriculture and food production within our cities and appreciation of social gathering for harvests and seasonal timing. (Smith, 2020)

Potential Bush Food Tree Planting

Araucaria bidwilli (Bunya Pine / **Buhnyi**) - Bush fruits
Backhousia citriodora (Lemon Myrtle / **Wom-bai**) - Bushleaf flavouring and teas
*Banksia integrifolia*** (Coastal Banskia / **Courriddjah**) - Nectars and sweet drink
Davidsonia pruriens (Davidson's Plum / **Orray**) - Bush fruits
*Ficus rubiginosa*** (Port Jackson Fig) (**Dthaaman**) - Bush fruits
Leptospermum petersonii (Lemon-scented Tea Tree) - Bushleaf flavouring and teas
Macadamia integrifolia (Macadamia / **Boombera**) - Bush fruits
*Podocarpus elatus*** (Illawarra Plum / **Daalgaal**) - Bush fruits
Syzygium leuhmannii (Riberry) - Bush fruits

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Potential Other Smaller Shrubs and Groundcovers - For podiums/ Greenroofs and Urban Community Gardens

Austromyrtus dulcis (Midyimberry / **Midgen**) - Bush fruits
*Billardia scandens*** (Apple Berry / **Bomula**) - Bush fruits
*Correa alba*** (Cape Barren Tea) - Bushleaf flavouring and teas
*Kennedia prostrata*** (Running Postman / **Kabin**) - Bushleaf flavouring and teas
Leptospermum flavescens (Swamp Tea Tree / **Tantoon**) - Bushleaf flavouring and teas
Microcitrus australasica (Finger Lime) - Bush fruits
*Tetragonia tetragoniodes*** (Warrigal Greens) - Bush vegetable

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** Denotes endemic to Sydney region

Figure 4.14 – Good opportunity exists to foster an opportunity to greater understand indigenous culture and the long held connections to the land and living things through tree species and green infrastructure. (Photo: Arterra)

4.7 New Tree Planting - General Principles

The following points outline the broad strategies that are currently recommended for adoption throughout the Paint Shop Sub Precinct.

- Utilise **large civic-scale trees** such as Figs, Araucarias, Eucalypts and Agathis to provide signature and landmark trees at key visual points and to allow trees to be seen out of windows even many storeys above the ground level. This will also assist in achieving the greening and tree canopy coverage targets (refer Figure 4.13)
- Incorporate trees and greenery into the upper levels of the future built forms and podiums and on roof tops to improve canopy coverage and increase peoples' connection to nature and greenery. The future urban designers should explore opportunities for **community orchard style planting** in semi-public open spaces/ roof terraces and podiums to provide urban food and community engagement with trees. This is not recommended in very public or major street contexts where maintenance, access and ownership issues prove difficult to manage. (Refer Figure 4.14 and 4.15)
- Consider the use of **trees and low level planting to line the internal streets, shared zones and laneways.** This will provide the opportunity to move trees away from potential future below ground services and future building facades and will allow the proposed trees to fully develop their canopies to achieve ultimate and optimum sizes. This is also the best way to fully shade pavements and parked cars and achieve the stated canopy coverage targets. The urban design teams and engineers should consider utilising structural soil systems and vaulted tree pit designs to allow soil volumes for vigorous and healthy tree growth in the long term, and under pavements. This form of planting, integrated with the streets, also serves to calm traffic and improves the general perceptions and use of the 'street' environment. (Refer Figure 4.16 and 4.17)
- Utilise **building setback zones** adjacent Wilson Street to allow planting and retention of the existing larger street trees. Consideration has been given to the building placement and provision of setback zones when in close proximity to the existing large Plane Trees, Camphor Laurels and Fig Trees, which are predominantly located on the southern and eastern sides of the Chief Mechanical Engineers Building and on the northern most boundary behind the existing Little Eveleigh residential dwellings.

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Figure 4.15– Good opportunity exists to provide productive landscapes and tree planting on the semi-public and controlled access areas of the raised tower podiums. These on-structure environments with good solar access provide the perfect arena for small scale and mixed orchard style tree planting that will offer not only amenity but facilitate locally sourced food and community based activity (Photo: Arterra)

4.8 Designing For Sustainable Tree Outcomes

Trees are **long term assets** and investments that may live for between 50 to 150 years, so species selection is vitally important. In contrast, most residents will only occupy their houses, on average, for a 5-15 year period.

Trees must be given the necessary requirements to sustain life - that is, space, air, water, nutrients, light and soil. To survive all trees must grow, and in doing so will inevitably shed leaves, bark, fruit, flowers and even branches. Their roots will grow and their trunks will expand. The challenge is to select the right tree for the right location within the urban forest that maximises the benefits and minimises the negative impacts to residents, infrastructure and road users. Careful planning, innovative design solutions and compromise are always needed when considering trees in busy and densely populated, urban environments.

Don't over plant for only short term or instant effects. A measured approach to planting should be adopted to allow future trees to mature with full and symmetrical canopies wherever possible. This generally makes the trees easier to manage in the long term, with better health and the ability to replace them more easily when the time comes. Such forethought often gives the trees more ability to seek adequate resources rather than completing with each other, above and below ground.

One of the key roles of the streets is to convey vehicles, pedestrians and utility services throughout the community. While there is often opportunity for tree planting as well, this is not so in all cases. It must be remembered that poor and or inappropriate tree planting may actually detract from a street's function and residents' enjoyment, and potentially create a serious burden on tree management resources both now, and well into the future.

Tree species will be selected so that the ultimate mature size of the tree canopy is appropriate to the particular street or space available and gives appropriate consideration to the site constraints, such as verge width, building alignments and vehicle clearances.

Some of the key considerations will be to ensure:

- Internal street profile designs accommodate and focus on trees as a key component of the infrastructure.
- Internal street orientations are planned with care to allow solar access to nearby residents and parks and using exotic deciduous trees where appropriate.
- Internal street hierarchy is reinforced by utilising species selections and signature trees to define key nodes and help define the desired hierarchy and use.
- Integration of trees as part of carparking areas or parallel parking bays.
- Integration of tree planting areas and tree pit designs within the bio-retention (rain-garden) and water quality treatment strategies.
- Provide and maximise deep soil areas to achieve optimum tree growth. This will make the most impact between tall buildings, along the internal streets and within the public open space areas. Trees with a spreading canopy can help to screen and alleviate the de-humanising influence of tall towers.
- Ground level gardens to provide interest and delight at street level but also accommodating wider and longer trees pits and spaces for tree trunks to grow and expand without undue damage to surrounding infrastructure.

4.8.1 Soil Volumes for Sustainable Tree Growth

Tree growth and soil fertility are strongly influenced by soil structure, as it affects the movement of air, water and nutrients. Well-constructed soil functions like a reservoir, enabling trees to accept store and transmit water, nutrients and energy and provide room for roots to expand and propagate. (Carpani, 2016, Lindsey and Bassuk, 1991)

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Tree roots typically grow in a shallow and wide plate-like arrangement (Refer Figure 4.16). They do this to maintain appropriate access to water, nutrients and most importantly soil oxygen. It is therefore more appropriate to provide wide and shallow rooting areas for all new trees. Tree pits with depths greater than 1.2 metres will typically be wasted as the tree will rarely access soil volumes at these lower depths. This is particularly relevant for the soils associated with the Sub-Precinct as the ability to achieve soil depths without excessive excavation are limited. Tree pit design shall typically be required to achieve the minimum soil volumes specifies below and have available minimum soil depths of ideally 0.8 metres. The typical maximum depth of soil that should be calculated and provided is 1.2 metre, unless very specific considerations are required.

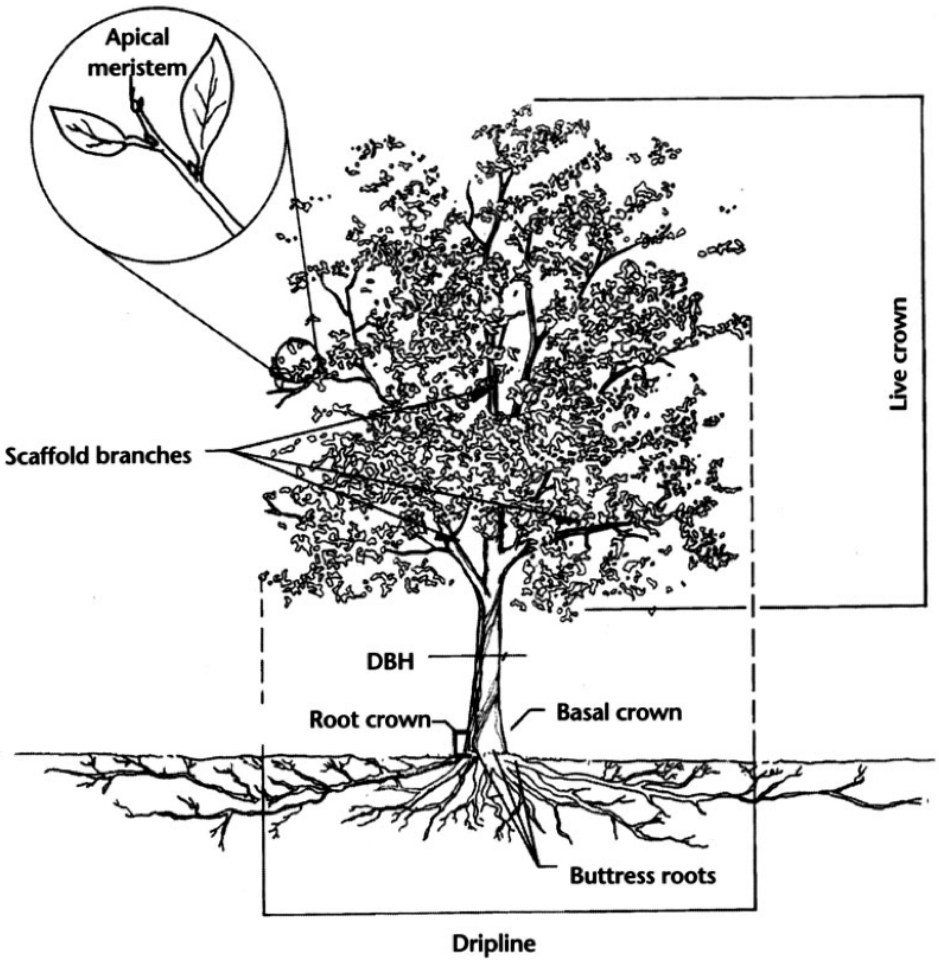

Figure 4.16 – Typical form and structure of a tree illustrating the typical form, location and extent of root growth (Source: Matheny and Clark, 1998)

The typical methods to achieve urban tree soil volumes include such systems as:

- Providing large open soil areas such as grass or garden areas immediately surrounding the new tree.
- Vaulted soil pits where pavements surrounding the trees are suspended just above the tree pit soils via suspended and reinforced concrete sub-pavements and piers and/or beams.
- Structurally supportive systems such as proprietary reinforcing systems like 'Strata Vault' and 'Strata Cells'.
- Structurally supportive soils (specifically designed and manufactured aggregate and soil mixes that provide a soil matrix capable of supporting pavements and loads while providing spaces for root development).

The opportunity exists for these systems to be utilised, where necessary, within the Sub-Precinct during detailed design. Any new trees should ideally be located within designated gardens or planting areas with sufficient space around the base of the trunks to allow for proper ultimate expansion of the trunk, root flare and its structural root zones. Trees should typically be planted at least 1.5 – 2.0 metres away from any walls, buildings or pavement edges, and even further for larger trees.

If planted within a paved area, the tree should be planted within a well-designed and designated 'tree pit' with sufficient surrounding soil volumes and drainage to prevent excessive infrastructure damage or premature tree failure and poor conditions in the future. When planting new trees within pavement areas or restricted areas the soil volume should be to sufficient to enable the tree to reach its mature size in a healthy and full state. To survive indefinitely a mature tree requires a minimum of 0.6 cubic metres of soil for every square metre of projected canopy area.

Figure 4.17–Numerous methods are now available of integrating trees and the necessary soil volumes within urban environments while still allowing pavements and roads to continue successfully above. The above illustrates the proprietary system Strata Vault by Citygreen being used at Barangaroo Sydney.

As a guide, for trees that are likely to achieve the following canopy spreads they should be provided with the following soil volumes:-

- 4 metres spread needs approximately 8-10 cubic metres of soil
- 6 metres spread needs approximately 20-25 cubic metres of soil
- 8 metres spread needs approximately 30-40 cubic metres of soil
- 10 metres spread needs approximately 50-70 cubic metres of soil
- 20 metres spread needs approximately 180-200 cubic metres of soil

The above guidance is in a normal street or landscape setting. The needs per tree can be marginally reduced if the trees can share soil volume with other adjoining trees or if the soil is subject to regular and permanent irrigation. In order to provide these volumes it will be very necessary to consider the following strategies highlighted previously being:-

- Use of expanded sized tree pits / planting areas.
- Use of structural soil systems (structural soils or plastic support mechanisms).
- Use of 'vaulted' soil pits with pavement bridging over the root zones.

An important consideration for this Sub Precinct, is the **existing constrained environment** where rock or heavy or compacted sub-soils may radically inhibit tree root development, putting further emphasis on the importance of providing adequate soil volumes at the time of design and planting. The above guidance with regard to soil volumes becomes much more pertinent to areas where the trees are located over rock, buried structures or on raised podiums or where other major infrastructure or building basements will inevitably inhibit the available rooting volume. It is also critical that all new trees are finally planted at the correct depths with any new soil and mulch carefully placed and allowing the top of the pre-existing root flare to just remain visible.

For trees planted within grassed areas, the base of the trunks should be surrounded with a minimum 3 metre diameter of recycled hardwood coarsely chipped mulch. This prevents the otherwise avoidable impacts to the trunk and root flare from mower and line trimmer damage. It is important the mulch is not too deep and is of a free draining nature. Excessively thick mulches or very organic mulches can become hydrophobic and actually prevent water from reaching the soil zone or introduce unwanted pathogens to the soil or tree.

4.9 Community Engagement and Education

An equally important component of the Urban Forest and Greening Strategy for Redfern North Eveleigh is to also ensure that the future proponents of the development educate the community and promote the benefits of green infrastructure and the urban forest. It will be important that as part of the ongoing implementation of development that the following goals are achieved:

- Promotion of the value of green infrastructure and urban forestry.
- Key stakeholder awareness of the importance of green infrastructure and urban forest initiatives.
- Encouragement of community stewardship of the green infrastructure and the urban forest.

Some of the suggested ways this community outcome could be achieved include:

- Investigate and support grants for community engagement and stakeholder collaborative projects such as community gardens, bush tucker gardens and community orchards.
- Organise awareness strategies such as "Great Tree Hunts" to look for significant trees, commemorative or indigenous trees around the area.
- Provide promotional brochures and information within public information and community centres.
- Collaborate with universities and local schools on research and involvement in green infrastructure and urban forest studies. Particularly health and wellbeing indicators to benchmark the role of urban forests in contributing to human health over long term studies.
- Ensure proper records are maintained for all public and private area tree planting (what species, numbers and sizes they were and when installed) and areas of garden installed. Council should insist on adequate and accurate 'Work as Executed' drawings and schedule for all installed trees as the project progresses and maintain a centralised repository of this information.
- Undertake annual resident workshops to educate the community about the local trees and conduct precinct tours.
- Utilise community tree planting days and similar celebrations.
- Organise 'Urban Forest' exhibitions that focus on ideas and artistic reflections of the trees and the urban forest (For example non-destructive/non-injurious sculptural installations within trees and lighting of trees, photographic exhibitions of trees and other green infrastructure within the precinct).
- Celebrity presentation and demonstration of gardens and urban forest planting (For example ABC Gardening Australia hosts and specials).
- Create outreach and education strategies such as:
    - Flyers / Brochure.
    - Educational field trips for local schools.
- Investigate a community "Adopt a Tree" program.
- Investigate opportunity for citizen training programs (pruning and maintenance) for example in NYC an exam qualifies residents to legally look after street trees (with some excluded areas). Volunteer groups receive work assignments and suggest further projects. 'Citizen Pruners' meet with Council to review tasks and receive training.

Figure 4.18 – Examples of some of the methods for encouraging community interaction and support for the urban forest including sculptural installations that celebrate trees, utilising material from former trees, and highlighting their morphology and spiritual connections. (Photo: Arterra)

Figure 4.19 – Trees themselves can be the frame for temporary artworks and lighting displays that can highlight the beauty, size and majesty of trees in the urban context. (Photo: Arterra)

Figure 4.20 – Green roofs and other open spaces and greening, such as Yerrabingin - South Eveleigh . (Source: Mirvac Website)

5. THE EXISTING TREES AND THE URBAN FOREST AND GREENING OUTCOMES

5.1 Overview

Why wait 30-40 years for shade and other benefits to develop when a mature tree already exists in the landscape. If there are existing trees that are healthy, stable and well placed, the primary objective shall be to preserve them.

The assessment of the tree related impacts and proposed protection measures within this document is 'high level' and put forward to assist with the appropriate assessment and approval of the Sub-Precinct's Concept Proposal. It also provides over arching guidance to future consultants and developers who may be responsible for the more detailed and site specific designs within the Sub-Precinct.

The realisation of the Sub-Precinct Proposal is considered to take at least 8-10 years to complete. It is, therefore, anticipated and expected that far more detailed and very site specific assessment of the existing trees identified to be retained as part of this overall assessment will be carried out and lodged with all detailed and site specific DA applications. It is important to note that trees are dynamic and living organisms and changes in their condition over time or relatively small changes to the proposed layouts or methods of construction may have significantly lesser or greater impacts on individual trees.

It is also important to note that the removal of the trees may also occur over an extended time frame. Not all the proposed removals will occur at one time, however many trees being removed have been identified as invasive weed species and their early control should be welcomed. Finally, desirable development outcomes and enhanced urban forest and greening outcomes should not be unnecessarily restricted by existing trees that are poor quality, very small, or potentially invasive.

5.2 Existing Trees and Proposed Retention and Removals

The proposed construction of the Paint Shop Sub-Precinct buildings and infrastructure will result in a major site disturbance. It is therefore necessary to remove many of the trees that currently exist. The design team have worked very hard to focus on the retention of the more important trees including:

- The mixed street trees along the southern side of Wilson Street
- The large Camphor Laurel tree and the Canary Island Date Palms south of the Chief Mechanical Engineers Building
- The large and architecturally interesting Fig tree to the north of the site and south of the existing residential development of Little Eveleigh St.

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There are 173 trees which have been assessed within the Paint Shop Sub-Precinct, of which 47 are of High and Moderate retention value, and 43 are currently being retained. There are 110 trees that are proposed to be removed, the majority of which are Low or Very Low retention value trees. The existing trees removed will be replaced with new, and more appropriately scaled and positioned trees as part of the staged redevelopment. It is proposed to apply a replacement offset strategy of 3 new trees for every 1 tree removed.

Figure 5.1 – Plan illustrating the existing trees to be retained and protected as part of the redevelopment . (Source: Arterra)

The following table summarises the trees to be removed and retained compared with their relative retention values. Refer also to the detailed schedules in Appendix 6.1 and plans in 6.3 for the location and graphical representation of the trees.

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Table 13 Tree Disposition Versus Their Retention Value

Tree Disposition	**Totals**	High Retention Value	Moderate Retention Value	Low Retention Value	Very Low Retention Value
Trees anticipated to be retained and protected	**63**	4 (100%)	39 (91%)	20 (37%)	0
Trees to be removed as they are within the footprint of the proposed buildings or other major streetscape or landscape works, or they were assessed as Low or Very Low retention value	**110**	0 (0%)	4 (9%)	34 (63%)	72 (100%)
Trees proposed to be transplanted	**-**	-	-	-	-
Totals	**173**	**4**	**43**	**54**	**72**

5.3 Managing Future Tree Impacts and Implementing Suitable Tree Protection Measures

Any future tree protection measures to be imposed as part of the development of the Sub-Precinct cannot be fully explored in detail until the exact nature and extent of the building and infrastructure development is deigned in detail. The following broad guidelines, however, are given as an indication of the likely measures that would be required to protect the tree assets, as the designs are developed.

The proposed construction of the buildings, streets and high-rise developments will result in major site disturbances. This would potentially have significant impacts on the trees within and adjacent to buildings, streets and other civil works. Specifically the proposed development will involve:

- Major demolition works;
- Use of large scale civil work, piling rigs and earthmoving equipment;
- Access to and from the construction sites with large trucks and construction plant;
- Excavations for the upgrading and placement of new road profiles;
- Excavations for the creation of improved tree planting soil profiles;
- Large stockpiles/ storage of construction materials;
- Re-grading and filling of the surface levels;
- Major services upgrades and associated infrastructure works;
- Use of large cranes;
- Parking for site personnel and deliveries;
- New streets, paving and retaining walls and
- Landscaping and new tree planting.

Given the high level nature of the Concept Proposal all that has been able to be calculated and assumed at present is that:

- All Low and Very Low retention value trees within the site boundaries will be **removed;**
- All trees that **fall within the currently anticipated buildings** or new street footprints or in other known areas likely to be re-graded or affected by major services installation have been shown removed;
- Attempts have been made to **focus on retaining and protecting the high and moderate** retention value trees;
- Due to the scale of developments, the **63** trees identified for retention could still **suffer some impacts,** to various degrees, by surrounding construction or infrastructure works. Specific efforts and measures

must be put in place during detailed designs to minimise root loss and other impacts as the developments proceed;

- **Detailed arboricultural impact assessments** will be required for each site specific development application. All reasonable attempts must be made to retain and protect the trees that are currently identified for retention as part of the Concept Master Plan. Minor incursions (<10%) will typically be accepted, but for any major encroachments (either above or below ground, as defined by AS4970) it will normally be expected that far more rigorous and site specific investigations will be carried out by a qualified Consulting Arborist (AQF5) and submitted as part of any detailed Development Application, to verify and hopefully support the retention of the tree(s); and
- As part of the above, the professional and thorough **tree protection measures must be applied** and then enforced for all trees proposed to be retained, throughout the demolition and the construction process.

Some of the more specific and critical tree protection measures that should be applied moving forward are further expanded on in the following sub-sections.

5.3.1 Design and Realistic Expectations

The best tree protection measure is to consider the retention and physical requirements of the trees to be retained during the detailed design stages. Most importantly a tree to be retained should be given the appropriate space to grow below ground, and above ground, and continue to develop new growth and prosper for many years to come. As much as possible, all work, including trenching, building construction and landscaping should be avoided within the identified Tree Protection Zone (TPZ) limits. The relevant TPZ radius of all trees are identified in Appendix 6.1.

The site planning, as part of the current Sub Precinct Concept Proposal, has identified and attempted to protect important and larger trees through the use of appropriate setbacks and offsets. Where an incursion is required to an existing tree and the design cannot be modified or amended, the amount of disturbance and incursion must be limited and appropriate compensatory areas applied and protected elsewhere and contiguous to the remaining TPZ around the tree(s).

Where adequate protection is not possible, or is unlikely or unable to be rigorously defended, then serious thought should be given to removing the tree and ultimately replacing it with new and advanced size tree planting at the completion of the development. This is preferable to wasting a lot of time, resources and development energy on retaining a tree that will almost inevitably decline and die.

5.3.2 Services Upgrades and Installations

Apart from physical street and building locations, services installation and upgrades are likely to have the next greatest impact on any existing trees and tree retention. There will be a need to very carefully consider the location and extent of all future trenching, and particularly for any major service upgrades.

There may need to be **consideration given to service re-alignments or under-boring** techniques to manage impacts to existing trees currently identified to be retained. Trenching past large and very well established trees, with traditional methods, often has very significant impacts on tree health. This is particularly relevant to the retention of the existing street trees on Wilson Street and the trees surrounding the Chief Mechanical Engineers Building.

Typically new services that are going to impact existing trees are to be under-bored, where ever practicable, thereby minimising incursion to any retained trees' root zones. Alternatively new services are to be rerouted and located suitable distance away from any existing trees.

5.3.3 Soils, Excavation and Demolition

In higher clay content and shallow soils, such as those found within the Sub-Precinct, soil compaction is a real concern. This is especially if the soil is trafficked when wet and allowed to then set hard when dry. This often leads to difficulty in the soil absorbing surface water and soil oxygenation, thereby restricting tree root growth. Some critical considerations with regard to tree protection are outlined below:

- **Demolition**. Roots may have been inhibited by retaining walls and road pavements and it is highly likely that roots will be found in irregular patterns around the trees and even under adjoining structures and roadways. This will make demolition of existing structures particularly difficult when close to existing trees. In some instances, existing infrastructure may need to be partially retained close to the trees to ensure trees are not disturbed and they remain structurally stable.
- **Exploratory, non-destructive root investigations** – Where necessary it will be expected that during detailed designs, developers may need to undertake exploratory, non-destructive root mapping and investigations (ie: using air spades, water jets or hand excavation) for some large or significant trees to verify location of any major roots and to guide final pavement levels and subgrade preparations. This will be particularly required where major incursions are proposed into any nominated TPZ areas or structures are proposed to be installed anywhere within Structural Root Zone areas (SRZ).
- **Construction period management**. All excavations undertaken near mature trees are to be undertaken and retained using suitable sheet, soldier or contiguous piling techniques. Even relatively small excavations, when done near trees are to be retained using soldier piling or similar to prevent any excessive battering into tree root zones. Soil compaction or waterlogging caused by construction activities will likely also be a concern. Soil compaction results in increased soil density, reduced porosity, and leads to increased root penetration resistance and a degredation of soil structure. It will be important, therefore, that soils within any tree protection area are protected from compaction and other disturbances, particularly when wet.

5.3.4 Tree Protection Fencing and Definition of TPZs

Prior to any works, including demolition, a clearly defined tree protection zone must be established. At a broad level, these have been defined in Figure 5.5 "Tree Protection Zone Plan". Demarcation of this shall typically be via a 1.8 metre high temporary fence with either plywood hoarding or temporary steel mesh or chain wire fencing with adequate lateral bracing. Fencing shall comply with the requirements of AS 4687-2007 Temporary fencing and hoardings. These areas around the trees shall be clearly delineated as a "Tree Protection Zone" during the remaining construction process, via appropriate weatherproof signage. Access shall typically be excluded from these zones and the ground levels will be left largely at the existing levels with the exception of the installation of new topsoils (where approved) and 75 millimetres of mulch. No stockpiling, excavation, trenching, re-fuelling or material storage shall be allowed in these areas. (Refer Figure 5.2)

If any construction work is required with in a TPZ, this work should be done with small tracked equipment or by hand, with care to limit damage and disturbance of the root zone. All works within TPZ zones must be witnessed and directly overseen by a qualified (AQF5) consulting arborist.

5.3.5 Ground Protection within TPZs

Vehicular movement and access shall typically not be required or approved through the TPZ areas. If it is absolutely necessary and it is proposed to create any access or haul road, or similar, within the TPZ of a retained tree, the Contractors shall install rumble strips or boards over the TPZ ground surface. No excavation shall be allowed. The Contractor shall first place a suitable permeable geotextile to the extent required and then a 100 millimetre thick layer of wood chip mulch or coarse no-fines gravel over the extent to be covered with the rumble strip / boards. They shall then place hardwood boards (minimum 3600 x 200 x 75 millimetre) on their flat edge, side by side, with a 30 - 50 millimetre gap to form a rumble strip. These boards are to be held together with galvanised metal bracing straps nailed to each board. The two outer straps are to be approximately 200 millimetre in from the ends of the boards. A third strap is to be along the centre line of the boards. (Refer Figure 5.3)

5.3.6 Trunk and Lower Branch Protection

A trunk protection barrier is to be erected around the circumference of any tree trunk, trunk flare and root buttress where indicated on relevant consulting arborist plans, especially when equipment or vehicles have to pass close to the tree. This barrier shall consist of a double layer of suitable perforated plastic pipe, 'used' artificial grass matting, carpet or carpet underfelt placed around the trunk. A layer of battens is to be placed over the padding. The battens are to have a maximum spacing of 50-100 millimetre. The height of the battens is to be at least 2.4 metres or to the height of the first branches. Lower large branches may require the same protection if they are likely to be damaged by passing vehicles or equipment. Secure in place with galvanised steel bracing straps. Do not nail into or otherwise injure the trunk or bark. Battens may be made from any suitable waste timber of similar sizes and depths. All sharp or protruding edges are to be properly covered with tape or similar padding. (Refer Figure 5.3)

Figure 5.2 – Example of appropriate TPZ mulching, tree protection and construction fencing (Photo: Arterra)

Figure 5.3 – Example of a temporary trunk protection (L) and ground protection (R) to be installed during construction periods. This can be a very valuable way of ensuring tree health and preventing accidental trunk damage and compaction of ground or disturbance of roots when work is undertaken close to trees. (Photo: Arterra)

5.3.7 Temporary Irrigation Systems During Construction for Key Trees.

The provision of supplementary irrigation is very beneficial to sustain good tree health while construction activities are undertaken. A temporary and automated watering system should be be typically placed within the TPZ of trees to be retained (except Wilson Street street trees) to maintain adequate water to the retained trees and help maintain and even improve their health and condition.

5.3.8 Controlled Construction Access and Parking

Construction access points, stockpiling and storage areas must be clearly identified and fenced where appropriate. Uncontrolled access points and parking of vehicles outside of designated areas is to be avoided. If temporary access is required through a tree protection zone, ground protection shall be employed to limit soil compaction and root damage and disturbances.

5.3.9 Clearing and Removal of Existing Trees to be Removed

Removal and clearing of existing trees within 15 metres of existing trees to be retained shall only be done by qualified arboricultural personnel with care not to impact or damage other surrounding trees throughout the process. Existing stumps should be ground out in a controlled fashion to remove wood that may decay and promote unwanted pathogens.

5.3.10 Communication - Tool Box Meetings and Construction Inductions

All contractors and subcontractors should be inducted prior to working on the site. All inductions should include description and identification of the Tree Protection Zones and the restriction on work and activities with regard to trees. The site foreman shall ensure that all new staff and contractors are appropriately inducted and that brief "tool box" meetings are conducted daily to ensure tree protection is maintained at the forefront of all construction workers' minds.

Figure 5.4– Example of a temporary irrigation system provided to trees during construction periods. This can be a very valuable way of ensuring tree health and vitality is maintained and also promote new fibrous root growth closer to the trees. (Photo: Arterra)

Figure 5.5 – Map of the Precinct illustrating the retained existing trees and the proposed Construction period "Tree Protection Zone Plan". Updated and detailed tree assessments, as per AS 4970 to be prepared at the relevant DA stage (Source: Arterra)

5.4 Key Greening Performance Measures and Proposed Targets

The principle objectives for the Sub-Precinct, that relate to the urban forest and greening initiatives, are to create a safe welcoming and healthy place to live, high quality public spaces, and a sustainable and adaptable urban environment. The principles, therefore, are to:

- Maximise green cover and tree canopy coverage.
- Provide a resilient, healthy and diverse green infrastructure and urban forest.
- Provide an integrated and systematic long-term strategy that promotes green infrastructure and trees as critical infrastructure and assets.
- Retain and protect the important existing trees.
- Educate the community and promote the benefits of green infrastructure and the urban forest.
- Undertake appropriate and targeted additional tree planting to meet industry and community best practice targets.

The targets that are considered particularly relevant in achieving these principles and that can be measured at this stage of the project are outlined in the table below.

Table 14 Key Targets and Performance Indicators for the Sub-Precinct

Urban Forest and Greening Consideration	Proposed Target for Sub Precinct
Overall 'Green Coverage'	40%
Overall Tree Canopy Coverage	25%
Tree Canopy Coverage by Landuse **(East of fan of Tracks)** Parks Street Private	 70% 60% 15%
Tree Canopy Coverage by Landuse **(West of Fan of Tracks)** Parks Street Private	 10% 15% 5%
Green Roof Provisions	50% of area (to new buildings) (either 100% to half of the new buildings or 50% coverage to all new buildings or an adequate combination of the these percentages)
Existing Trees Identified for Retention High Value Trees Moderate Value Trees	 100% > 90%
Species Diversity In any one Family In any one Genus In any one Species	 < 40% < 30% < 10%
Tree Size Class Civic Large Medium Small	 10% 30 - 35% 50 - 55% < 10%
Ecological Contribution / Diversity Naturally Endemic to Sydney Bioregion Australian Native Exotic Weed / Invasive/ Non-desirable	 > 20-25% 50-55% < 20-25% < 1%

5.4.1 Canopy and Green Coverage

Most pleasingly, and importantly, is the realistic and demonstrated ability for the Sub Precinct to achieve good greening and urban tree canopy coverage targets. It is the author's opinion that the pre-existing tree canopy coverage will be substantially improved. Though some trees may need to be removed for access and building clearances, additional street tree planting in Wilson Street and additional planting of larger and medium trees within the Sub-Precinct, particularly in the eastern end should see the Precinct able to meet these expected targets.

Despite the highly urbanised development there appears to be very reasonable and realistic opportunity to meet the overall 'green coverage' target. This will be achieved by mandating green roofs on many of the new buildings and focusing on ground level greening through the new streets and parks, where it can be done without compromising other important urban design, access and heritage outcomes.

5.4.2 Species Diversity

The high level nature of the current concepts means that the actual species diversity can not be precisely measured or commented on. It is the clear intention of the concept proposal, however, to develop a diverse and appropriate mix of plants within the redevelopment. The selection of the new trees is intended to ultimately:

- Provide a mix of species that is culturally appropriate and respects the strong association with Indigenous culture and Connection with Country.
- Provide a mix of species that are robust, long lived with acceptable maintenance regimes that most importantly actively contribute to canopy coverage and urban shading and cooling.
- Install tree species that are appropriate to their positions and are well suited to uses in streets, civic spaces and highly used urban areas.
- Minimise the reliance on the Myrtaceae Family to acceptable levels, ideally not exceeding 40%, but certainly no more than 50% of the total trees planted.
- Contribute to an acceptable balance of locally endemic, native and exotic trees, recognising that exotic trees will still play very valuable roles for urban shading and winter sun and providing trees that provide appropriate scales and wind tolerance in relation to the proposed tall towers and potential wind tunnel affects.

It is expected there is likely to remain a heavy reliance on the Myrtaceae family, which is very common throughout Australian cities. The diversity achieved from the proposed replenishment planting across the overall Sub Precinct should moderate the figures towards the desired outcome. Ultimately it is more important that the right type of tree is proposed for each given urban situation, microclimate and the spaces available and provided.

The selection of proposed trees, as provided in Appendix 6.2, is believed to be a balanced and appropriate selection and should form the basis for the majority of ongoing tree selections in the coming years. It is expected, this listing may need to reviewed should additional research become available (ie. Which Plant Where), new pest or diseases become identified, or suitable new and improved urban species trials are undertaken or are developed commercially.

5.4.3 Tree Size

There is a likely to be a general reliance on medium sized trees, which is reflective of the common spaces and type of landscapes and streets to be created around the Sub-Precinct. The capacity certainly exists for the extensive use of larger and civic-scaled trees in parts of the Sub Precinct, particularly with in the Parks. Again, in the author's opinion, it is more important to ensure the right type of tree is proposed for the given urban situation and spaces provided. We continue to recommend that efforts be applied to identify placement of civic-scaled (extra large trees) such as Figs, *Agathis* and *Araucarias* and some of the larger Eucalypt species at key nodes and focal points around the Sub-Precinct. This will aid in the provision of overall canopy coverage and aid in achieving the desired targets for larger tree sizes.

5.5 Water and Greening

The twin challenges of modern-day stormwater management and climate resilience requires our urban developments to depart from out-dated and traditional approaches and implement a new view on water infrastructure. The more that we embrace integrated stormwater management, the more we will have a cleaner, greener future where we are able to better manage risks, keep water costs low, and provide the widest possible range of environmental, economic and social benefits. It will also reduce our reliance and use of very valuable potable water. (Valderrama, A., 2018)

Water and plants are natural partners. Many natural systems rely on the initrinsic connection between plants and water. Plants require water for photosynthesis and growth, and without adequate water plants will die. Plants also contribute to the natural cycle of water through the landscape, as their roots absorb moisture from the soil and transpire it into the atmosphere. In doing so, they effect local humidity and temperature. (CoS-GSS, 2021)

Mutual benefits are gained from a more sustainable and integrated approach to water management. For example, recent stormwater studies conducted in Melbourne reveal that the integration of trees within 'rain gardens' has the potential to markedly increase the evapotranspiration of water from the 'rain gardens' and therefore further reduce volumes of stormwater runoff (Thom, Jasmine K. 2020).

The design of the Sub-Precinct should focused on using the local water as a resource to increase and sustain the greening initiatives. Renewed efforts need to be placed on conserving, capturing and reusing water that would otherwise be collected and immediately discharged . Potential opportunities to enhance and reconnect water and green infrastructure exist at all scales, and includes:

- Diverting storm water to green landscaped areas and trees whenever possible;
- The use of permeable pavements (where hard surfaces are necessary) to allow water to recharge ground water storage;
- The local collection and storage of storm water for use in efficient landscape irrigation;
- The local treatment of wastewater and distribution for use in private and public greening;
- Promoting the greening of previously hard surfaces, including available space within roadways and rooftops;
- Ensuring the use of 'smart' irrigation systems linked to soil moisture, weather and other sensors to avoid waste; and
- Careful species selection that balances drought and heat tolerances, together with the need for transpiration and shading.

Figure 5.6– Example of a rain gardens, WSUD and tree planting at Harold Park redevelopment, Glebe, that would be equally applicable and expected at the Paint Shop Sub-Precinct. (Photo: Arterra)

Investing in a landscape driven approach to sustainable water management can cost less to construct, can reduce the amount of impervious surfaces, can manage or eliminate stormwater runoff more effectively than conventional approaches. Inspired by nature, these predominantly vegetative systems also provide ancillary benefits that underground pipes and concrete channels do not, including:

- conserve water and embodied energy;
- reduce urban heat island effects and reducing thermal gains in our harbour and waterways;
- recharge groundwater supplies;
- create additional habitat and supporting biodiversity;
- buffer and reduce noise, sediments and other pollutants;
- improve human health and comfort;
- provide more adaptive, multi-use, attractive and resilient infrastructure; and
- make water and pollution more visible and re-educate people about waters use and benefits (Liptan, T., 2017).

Conceptually, it is envisaged that the designs utilise and extensively collect and re-use a majority of rainwater and a substantial component of the Sub-Precincts generated grey water to irrigate and sustain the expected green infrastructure, both public and private. Street and open space designs shall typically direct surface water and runoff, wherever technically possible, towards existing and new trees and other green infrastructure to passively irrigate the plants in an ever-warming climate.

Integrated water management will be addressed in the next phase during design development. The preference will be for a site wide and precinct scale water harvesting and collection, storage and re-use outcome. At present it has been calculated that the water needs of the green infrastructure will not be met by natural rainfall alone and therefore an integrated approach to water storage and re-use will be required to create a 'water positive' development.

However, regardless of the final project delivery method and governance structure, as a minimum, every new development will be expected to provide for and cater for its own water and irrigation needs, suitable to sustain the required and expected green infrastructure. Each development parcel must also contribute some component and make a proportionate contribution to the water needs of the public domain greening. Refer to also to the Environmental Sustainability report by Arup and the Utility and Site Servicing Strategy by Aecom for further information and commentary that support this proposal.

Figure 5.7– Example of a Precinct scale water recycling facility at Darling Island within the nearby CoS area that would be equally applicable and ultimately expected within the Paint Shop Sub-Precinct to help ensure the ultimate sustainability of the proposed Green Infrastructure. (Photo: Arterra)

5.6 The Suitability of the Proposed Tree Species

The relatively high level public domain plans currently prepared for the Sub-Precinct Concept Proposal indicates there will be a range of tree species proposed and provided throughout the redevelopment. There is a selection of proposed trees provided within Appendix 6.2 which should form the basis for all new tree planting within public and semi-public areas. They are considered generally appropriate to the normal constraints and conditions likely to be imposed by the local urban surroundings and will positively contribute to the implementation of the objectives of the Sub-Precinct. All new tree planting must still be considered with relation to the individual microclimatic, spatial and soil conditions expected within each development parcel, street or park.

Specifically the proposed species put forward are considered appropriate for the following reasons:

- There is a range of species that provide both deciduous and evergreen trees.
- They are all hardy proven performers within relevant urban contexts.
- The species generally are diverse enough to achieve civic, place making and cultural outcomes.
- Some deciduous trees are recommended for solar access during the cooler months which should be applied to some parts of the public open spaces, streets and to northern or western sides of buildings. They may also facilitate seasonal views to important buildings or other features.
- It provides a balanced approach to diversity with a dominance of trees native to the NSW coastal region with *Corymbia, Eucalyptus, Syncarpia and Angophora* species, as well as providing seasonal flowering nectar food sources for native fauna and insects.
- Provides trees that provide reliable shading and canopy coverage with a large proportion of the trees providing excellent shade and evapotranspiration rates that will help mitigate urban heat island effects (eg. *Ficus obliqua*, *Ficus rubiginosa*, *Lophostemon confertus, Waterhousea floribunda, Syzygium paniculatum and Harpullia pendula*).

Any future detailed designs should generally align with the proposed public domain plans, species selections, the proposed road and building setbacks and available horizontal spacings.

5.7 Proposed Design Guideline Control Provisions Relating to the Urban Forest and Greening

The following are the proposed Urban Forest and Greening Design Guidelines that should be adopted for the Paint Shop Sub-Precinct. Many of these simultaneously contribute to the realisation of wider Precinct objectives and sustainability requirements.

1. Any existing trees identified and proposed to be retained as part of the Sub-Precinct Master Plan are to be assessed in detail prior to any detailed design work around them and then protected as per the requirements outlined in the Australian Standard 4970 – Protection of Trees on Development Sites.

2. If existing trees occur within the planned under ground routes of new or upgraded services then suitable mitigation measures shall be employed to avoid incursions into the tree(s) calculated Tree Protection Zones, as defined under Australian Standard 4970 – Protection of Trees on Development Sites. Where this cannot be reasonably accommodated, alternative methods of construction shall be thoroughly investigated and used such as under-boring, directional drilling or non-destructive trenching techniques to install the services without impact to the trees' health or stability.

3. The target for **Urban Canopy Cover** shall be a minimum of **25%,** averaged across the Sub-Precinct and the **Green Cover** Target shall be a minimum of **40%,** averaged across the Sub-Precinct. The Sub-Precinct shall generally be considered as two equal sized but distinct '**greening zones**', defined via the eastern edge of the broad sweeping line of the main 'Fan of Tracks'. The area generally north and east of the Fan of Tracks shall be focussed heavily on overall greening and particularly on the provision of urban tree canopy coverage. The area to the south and west of the Fan of Tracks shall be focussed on the provision of 'green cover' through provision of ground level greening, WSUD implementation and building roof gardens, with far less emphasis on trees. Using this philosophy the following targets are proposed in order to achieve the required Sub-Precinct wide average.

Table 14 Proposed Tree Canopy Cover Calculations by Landuse Type

TREE CANOPY COVERAGE Target Versus Land use	**Approx m2 of Landuse**	**CANOPY % Target**	**m2 of CANOPY COVER**
NORTH/EAST of FAN OF TRACKS		-	-
Public Park and Open Space	6,200	**70%**	4,340
Street	8,400	**60%**	5,040
Private Property	12,300	**15%**	1,845
Sub Total	26,900(49%)	Average 42%	11,225
SOUTH/WEST of FAN OF TRACKS			
Public Park and Open Space	8,400	**10%**	840
Street	5,700	**15%**	855
Private Property	14,100	**5%**	705
Sub Total	28,200 (51%)	Average 9%	2,400
TOTAL ACROSS PRECINCT	55,100 (100%)	**25%**	**13,625**

Table 15 Proposed Overall Green Cover Calculations by Landuse Type

'GREENING' COVERAGE Target Versus Land use	**Approx m2 of Landuse**	**GREEN COVER % Target**	**m2 of GREEN COVER**
NORTH/EAST of FAN OF TRACKS		-	-
Public Park and Open Space	6,200	**85%**	5,270
Street	8,400	**75%**	6,300
Private Property	12,300	**30%**	3,690
Sub Total	26,900(49%)	Average 57%	15,260
SOUTH/WEST of FAN OF TRACKS			
Public Park and Open Space	8,400	**15%**	1,260
Street	5,700	**20%**	1,140
Private Property	14,100	**30%**	4,230
Sub Total	28,200 (51%)	Average 24%	6,630
TOTAL ACROSS PRECINCT	55,100 (100%)	**40%**	**21,890**

4. 'Canopy Coverage' shall be measured as the 'projected' square metre canopy from the trees using reasonable estimates of the likely ultimate mature size of the chosen trees within an urban setting within a 30-50 year period. Overlapping canopies must not be counted more than once. Coverage may include trees planted at ground level as well as any trees planted in upper levels of buildings, such as podiums or roof tops. It may also include any canopy overhanging from an adjoining public domain area. A 'tree' shall be as defined by the CoS LEP. 'Green Coverage', which includes all greenery such as tree canopy cover, lawns, gardens and green roofs and wetlands shall be shall be measured as the 'projected' square metre coverage as calculated and as defined by CoS Greening Sydney Strategy 2050. Overlapping canopies and greenery must not be counted more than once.

7. Tree species selection for the public domain shall be as per the proposed tree species list contained in Appendix 6.2. Small trees shall only be used where it is unreasonable to install a larger tree. This is to avoid the use of small trees where the space otherwise clearly exists for a larger tree to be planted.

8. Where reasonable and practical to do so, a designed mixture of a minimum of 3 species from different botanic families shall be chosen for the primary streets and open space areas of the Sub-Precinct to prevent the likelihood of any catastrophic canopy and greening loss due to climate change, droughts and pests in the future.

8. Planting throughout the Precinct shall typically aim for a balance of tree sizes with the following proportion of trees, by total number, to be achieved:
    - 10% civic (extra large trees) (minimum of 25 metre in spread and/or height)
    - 30-35% large trees (minimum of 15 metre in ultimate spread and/or height)
    - 50-55% medium trees (minimum of 10 metre in spread and/or height)
    - no more than 10% small trees (less than 10 metre in spread and/or height)

9. Designs shall incorporate a diverse range of species into the final designs to increase resilience and diversity and achieve the commonly accepted targets of no more than:
    - 40% in any one family,
    - 30% in any one genus,
    - 10% in any one species.

10. Future designs for any development parcel shall demonstrate that the irrigation and sustainable long term provision for green infrastructure provided as part of their development can be met by non-potable water sources. Ideally, all development parcels shall aim to intercept, utilise and extensively collect, store and re-use the majority of rainwater able to be collected**.** Where this falls short of the longer term needs of the tree, shrub and ground cover planting, a suitable component of its generated and suitably treated grey water shall also be provided to irrigate and sustain the expected green infrastructure. All development parcels must also make a demonstrated and proportional contribution to the adjoining Sub-Precinct's wider public space irrigation requirements.

11. All street, shareways and open space designs shall typically direct surface water and runoff, wherever technically possible, towards existing and new tree planting and other green infrastructure to passively irrigate the surrounding plants in an ever-warming climate.

12. When planted within a potentially constrained soil environment (for example on-structure or where other subsurface conditions would be expected to constrain root development and available rooting volumes) all trees are to be planted in accordance with the soil volume requirements contained within Section 4.8.1 of the Redfern North Eveleigh Paint Shop Sub-Precinct Urban Forest and Greening Study.

13. An offset ratio of a 3 :1 shall be applied for replacement tree planting. For any existing tree removed at least 3 similarly sized trees shall be planted as replacements within the Sub-Precinct.

14. All new street trees to be planted are to achieve a minimum of 0.8 metre setback from the face of adjoining road kerbs or parking lanes with 1 metre - 1.5 metre preferred. Trees shall be planted typically a minimum of 3 metre away from the face of any adjoining building.

5.8 Typical Technical Requirements for New Tree Planting

Considerable effort and resources can be spent in planting new trees. This considerable effort can be wasted if the tree dies shortly after planting, or if the tree is supplied in a substandard form or condition that may ultimately lead to poor performance or the later development of serious structural defects and poor health. If new tree planting is not well considered and applied the ultimate benefits espoused in this document may never be realised. It is therefore important that the following basic requirements are enforced.

5.8.1 Planting Programs and Timing

The implementation of any new tree planting needs to be carefully planned and considered. This will involve the critical elements below:

- The quality and species of the trees planted;
- The size at which they are planted; and
- The way they are physically planted and cared for in the first few weeks and months.

The following outlines the **minimum** requirements that should be adopted for new tree planting within the Sub-Precinct

- All new street tree planting shall be a minimum of 200 Litre container sizes with this increased to 400 Litre, for the key feature trees, being preferred. Sizes of >800 Litre should be considered where suitable and quality advanced stock is available.
- All trees shall be grown to the minimum standards of AS2303 – 2015 Tree Stock For Landscape Use with certification provided by the supplying nurseries. Trees shall be true to type and the species and the cultivars specified.
- Tree planting should ideally be undertaken in either Autumn or Winter. This will greatly increase the success of the planting and reduce the establishment maintenance burdens.
- Soil volumes provided shall be consistent with the requirements for the size and species of the tree as outlined in this document.
- Surrounding pavements and any installed tree grates shall allow for proper expansion of the trees base over time.
- Trees should be planted suitable distances from adjoining kerbs and buildings. Distances greater than 1000 millimetres from kerbs, walls and pavement edges are preferred.
- Trees shall be transported, lifted and planted in a manner that limits any possibility of physical damage.
- Trees shall be regularly maintained for a minimum of 24 months from the date of planting to ensure adequate establishment maintenance. This is to include pest and disease monitoring and control, watering and timely replacement of any failed trees, if required.

5.8.2 Tree Stock Quality and Sourcing

Considerable effort can be wasted if new trees die shortly after planting, or if the tree is supplied in a substandard form or condition that may ultimately lead to poor performance or the later development of serious structural defects and poor health. As outlined by authors such as Gilman (Gilman 2012), most tree defects that occur in mature trees were present and identifiable at the time a tree was initially planted. It is therefore essential that the tree and its roots be in optimal condition when delivered and planted.

An important aspect of the implementation is in the planning and procurement of nursery stock. Implementing a 'forward-thinking' and pre-planned approach to plant procurement has numerous benefits, which include:

- Securing favourable contract growing prices.
- Ability to prepare and coordinate planting at optimum times of the year.
- Ability to purchase trees of the required species and cultivars.
- Ability to purchase trees of the required sizes and dimensions and formatively pruned to suit street tree and park installation.
- Assurance of the required quantities, including allowance for replacements when necessary.
- Ability to inspect and demand high quality stock, free of above and below ground defects.

In summary, all trees should be sourced and supplied as part of an advanced plant supply contract with one or more reputable commercial suppliers and they shall conform to the NATSPEC "Guide for assessing the quality of and purchasing of landscape trees" by Ross Clark 2003 and AS AS2303 – 2015 Tree Stock For Landscape Use.

5.7.3 Early Establishment, Formative Pruning and Maintenance

Most defects that lead to tree problems and failures are present in trees upon delivery from the nursery and at planting. If stock is properly sourced, as noted above, most of the issues noted below should not present themselves. For example:-

1. Included branches
2. Co-dominant or tri-dominant stems
3. Congested branching architecture
4. Crossing and rubbing branches
5. Leans

If these issues do occur, however, they are to be properly managed through formative pruning. At an early age these problems seem insignificant and unimportant. The tree, branches and defects are relatively small. These branches however are often the trunks and branches that are the major branches of the tree when it matures and as it grows so do the size of the trunks and these branches. A 50 millimetre branch today will be the 200 millimetre branch in 10 years' time. Branches are typically at the same point in the tree in the future as they are when young. Plants elongate from the ends, and the early trunks and stems just expand in girth, they do not move upwards in the tree. That is, if the tree currently has a major branch at 1.5 metre high, that major branch will always be emanating from about 1.5 metre high on the tree. When it is small that may not be an issue, but when the tree is mature this may not be desirable for clearances under the tree.

Defects, where present, can become more serious if left untreated as the tree matures. The size of the tree will typically increase and the damage to persons or property, if failure occurs may become more significant. When a tree is mature the ability to rectify some of these defects can also become substantially more difficult and costly. It may also involve removing potentially very large branches or trunks, a lot of foliage and pruning into heartwood, thereby leaving substantial wounds that the tree expends substantial reserves trying to compensate for and seal around.

Formative pruning, although straightforward in theory, does require individual assessment and decisions based on each trees' specific needs. It is both 'art' and 'science' and should be conducted only by an experienced arboricultural professional and in line with AS4373 Pruning of Amenity Trees. Experiences from professionals such as Gilman indicate that in some younger trees foliage removal in the order of 40-50% is not an unacceptable figure and may be necessary in achieving the longer term desired outcomes.

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6. APPENDICES

6.1 Schedule of Existing Trees

Redfern North Eveleigh, UFS - Existing Tree Assessment Schedule

Tree ID	Trees in Group	Tree Species	Common Name	Genus	Family	Height (m)	Spread North (m)	Spread West (m)	Spread South (m)	Spread East (m)	Trunk Diameter Breast Height (dbh) (m)	Trunk Diameter at base (dgl) (m)	Nominal TPZ radius (m) 12xdbh (AS 4970)	Nominal SRZ radius (m) (AS 4970)	Age Class	Current Vigour	Current Form	Tree Origin	Tree Type	Noted Defects	SULE Rating	Street Tree	Precinct or Location	Retention Value	General Comments and Notes	Incursion and Impact	Recommendation
1	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	16.5	10.0	7.0	3.0	7.0	0.65	0.85	7.80	3.09	Mature	Good	Good	Exotic	Deciduous	Epicormic Growth, Asymmetric Canopy, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots growing over and along the kerb. Asymmetric canopy to the north east.	Adjoining street.	Retain
2	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Fair	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
3	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	12.0	6.0	8.0	1.0	4.0	0.50	0.69	6.00	2.83	Mature	Good	Average	Native	Evergreen	Lean-Minor, Epicormic Growth, Asymmetric Canopy, Tip Dieback	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Minor lean towards the road. Pruning to the north western side of the tree for road clearance.	Adjoining street.	Retain
4	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.06	2.00	1.02	Young	Poor	Poor	Exotic	Deciduous	Decay-Minor	Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Mechanical damage at the base of the trunk. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
5	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	13.5	9.0	7.0	1.0	5.0	0.55	0.78	6.60	2.98	Mature	Good	Good	Exotic	Deciduous	Epicormic Growth, Lean-Minor, Root Impacts, Asymmetric Canopy	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to the north western side of the tree. Roots growing over and along the kerb. Canopy conflicting with light pole on south east side of tree.	Adjoining street.	Retain
6	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	0.5	1.0	1.0	0.5	0.05	0.05	2.00	0.94	Young	Fair	Poor	Exotic	Deciduous	Asymmetric Canopy	Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
7	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	10.5	8.0	6.0	5.0	3.0	0.60	0.85	7.20	3.09	Mature	Good	Good	Native	Evergreen	Lean-Minor, Tip Dieback	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Minor pruning on the north eastern side for clearance. Exposed roots growing along kerb. Minor lean towards the road.	Adjoining street.	Retain
8	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	7.0	4.0	5.0	4.0	4.0	0.53	0.50	6.36	2.47	Mature	Good	Average	Native	Evergreen	Inclusions	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Multi-stemmed with inclusions.	Adjoining street.	Retain
9	1	*Eucalyptus camaldulensis*	**River Red Gum**	*Eucalyptus*	MYRTACEAE	6.5	6.0	5.0	5.0	5.0	0.55	0.69	6.60	2.83	Mature	Fair	Poor	Native	Evergreen	Lean-Major, Epicormic Growth, Tip Dieback, Cavity	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Pruning to north east for clearance. Minor hollow to east. Major lean towards and overhanging the road. Potentially dangerous to passing cars, cyclists. Vehicle impact likely.	Adjoining street.	Retain
10	1	*Melaleuca styphelioides*	**Prickly Paperbark**	*Melaleuca*	MYRTACEAE	6.5	2.0	2.0	2.0	2.0	0.40	0.35	4.80	2.13	Mature	Fair	Good	Endemic	Evergreen	Inclusions, Deadwood-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Slightly suppressed by overhanging canopies of adjoining trees on the north-east and south-west.	Adjoining street.	Retain
11	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	8.5	6.0	5.0	6.0	2.0	0.54	0.67	6.48	2.80	Mature	Good	Average	Endemic	Evergreen	Epicormic Growth, Co-dominant Stems, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning throughout the canopy. Surface roots throughout verge.	Adjoining street.	Retain
12	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	8.5	5.0	3.0	6.0	3.0	0.45	0.63	5.40	2.73	Mature	Good	Average	Endemic	Evergreen	Epicormic Growth, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning throughout the canopy. Roots exposed and growing over and along kerb. Surface roots throughout verge.	Adjoining street.	Retain
13	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	7.5	1.0	3.0	6.0	0.5	0.27	0.38	3.24	2.20	Mature	Fair	Poor	Endemic	Evergreen	Epicormic Growth, Lean-Minor, Asymmetric Canopy	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Asymmetric canopy to the south-west side due to adjacent trees. Canopy conflict on the western side due to light pole.	Adjoining street.	Retain
14	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	9.0	2.0	2.0	3.0	2.0	0.45	0.65	5.40	2.76	Mature	Good	Poor	Endemic	Evergreen	Epicormic Growth, Lean-Minor, Asymmetric Canopy, Congested Branches, Root Impacts	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Suppressed canopy on north-east and south-west sides. Conflict on the north-east with light pole. Exposed roots growing over and along kerb. Pruning to north and east. Surface roots throughout verge.	Adjoining street.	Retain
15	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	9.0	4.0	4.0	6.0	2.0	0.45	0.65	5.40	2.76	Mature	Good	Poor	Endemic	Evergreen	Epicormic Growth, Asymmetric Canopy	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Asymmetric canopy to the south-west. Exposed roots growing over and along kerb. Pruning to north and east.	Adjoining street.	Retain
16	1	*Schinus areira*	**Peppercorn Tree**	*Schinus*	ANACARDIACEAE	6.0	3.0	3.0	2.0	2.0	0.45	0.45	5.40	2.37	Mature	Good	Average	Exotic	Evergreen	Lean-Major, Tip Dieback	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Major bend in trunk towards the east at 1m above ground level. Unable to assess accurately due to trunk protection installed. Likely to be previously removed major stem to the north at that point.	Adjoining street.	Retain
17	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	8.0	3.0	3.0	7.0	4.0	0.40	0.60	4.80	2.67	Mature	Good	Average	Endemic	Evergreen	Epicormic Growth, Decay-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north and east.	Adjoining street.	Retain
18	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	8.0	6.0	6.0	6.0	3.0	0.50	0.70	6.00	2.85	Mature	Good	Average	Endemic	Evergreen	Epicormic Growth, Decay-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north and east.	Adjoining street.	Retain
19	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Fair	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
20	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	2.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Poor	Poor	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
21	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	12.5	7.0	6.0	4.0	4.0	0.55	0.70	6.60	2.85	Mature	Excellent	Average	Endemic	Evergreen	Deadwood-Minor, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Minor kerb displacement and cracking of kerb adjoining tree.	Adjoining street.	Retain
22	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Fair	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Relatively newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
23	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Fair	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Relatively newly planted, low value due to small and replaceable size.	Adjoining street.	Remove
24	1	*Koelreuteria paniculata*	**Golden Rain Tree**	*Koelreuteria*	SAPINDACEAE	3.0	1.0	1.0	1.0	1.0	0.05	0.05	2.00	0.94	Young	Fair	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
25	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	6.5	4.0	4.0	4.0	4.0	0.45	0.70	5.40	2.85	Mature	Good	Good	Native	Evergreen	Epicormic Growth, Lean-Minor, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots growing over and along kerb. Minor lean towards road. Surface roots throughout verge.	Adjoining street.	Retain
26	1	*Eucalyptus grandis*	**Flooded Gum**	*Eucalyptus*	MYRTACEAE	8.5	3.0	2.0	6.0	3.0	0.40	0.60	4.80	2.67	Semi-mature	Fair	Average	Native	Evergreen	Decay-Minor, Epicormic Growth, Deadwood-Minor, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots growing along and over kerb. Heavily pruned for clearance to power line and light pole. Surface roots throughout verge.	Adjoining street.	Retain
27	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	5.5	4.0	2.0	3.0	2.0	0.30	0.45	3.60	2.37	Mature	Good	Good	Native	Evergreen	Epicormic Growth, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots growing over and along kerb. Surface roots throughout verge.	Adjoining street.	Retain
28	1	*Eucalyptus botryoides*	**Bangalay**	*Eucalyptus*	MYRTACEAE	10.0	10.0	5.0	6.0	2.0	0.45	0.65	5.40	2.76	Mature	Fair	Good	Native	Evergreen	Tip Dieback	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north-east for road clearance.	Adjoining street.	Retain
29	1	*Eucalyptus botryoides*	**Bangalay**	*Eucalyptus*	MYRTACEAE	7.0	4.0	2.0	4.0	3.0	0.25	0.40	3.00	2.25	Semi-mature	Fair	Average	Native	Evergreen	Tip Dieback	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north-east for road clearance.	Adjoining street.	Retain
30	1	*Eucalyptus robusta*	**Swamp Mahogany**	*Eucalyptus*	MYRTACEAE	8.5	4.0	3.0	6.0	3.0	0.30	0.40	3.60	2.25	Mature	Fair	Average	Endemic	Evergreen		Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed surface roots throughout verge to south.	Adjoining street.	Retain
31	1	*Eucalyptus nicholii*	**Narrow-leaved Black Peppermint**	*Eucalyptus*	MYRTACEAE	7.0	6.0	6.0	5.0	4.0	0.35	0.40	4.20	2.25	Mature	Good	Average	Native	Evergreen	Epicormic Growth, Deadwood-Minor, Tip Dieback	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Pruning to north for road clearance.	Adjoining street.	Retain
32	1	*Eucalyptus sideroxylon*	**Mugga Ironbark**	*Eucalyptus*	MYRTACEAE	9.0	5.0	6.0	5.0	4.0	0.59	0.74	7.08	2.92	Mature	Fair	Average	Native	Evergreen	Co-dominant Stems, Inclusions, Epicormic Growth	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north. Exposed roots with minor kerb displacement. Inclusion at 4m from ground level. Generally poor form and sparse foliage.	Adjoining street.	Retain
33	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	8.5	6.0	4.0	2.0	5.0	0.35	0.50	4.20	2.47	Mature	Good	Good	Exotic	Deciduous	Congested Branches, Deadwood-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning wounds to south.	Adjoining street.	Retain
34	1	*Eucalyptus sideroxylon*	**Mugga Ironbark**	*Eucalyptus*	MYRTACEAE	9.5	6.0	3.0	5.0	6.0	0.47	0.67	5.64	2.80	Mature	Good	Poor	Native	Evergreen	Epicormic Growth	Long (>40 years)	Yes	Wilson Street	**Low**	Public street tree. Pruning to south. Extensive epicormic growth.	Adjoining street.	Retain
35	1	*Eucalyptus punctata*	**Grey Gum**	*Eucalyptus*	MYRTACEAE	13.0	8.0	4.0	7.0	4.0	0.44	0.50	5.28	2.47	Mature	Good	Average	Endemic	Evergreen	Decay-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruning to north. Mechanical damage to northern lower branch. Failure of central leader.	Adjoining street.	Retain
36	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	7.0	4.0	3.0	3.0	4.0	0.44	0.58	5.28	2.63	Mature	Good	Average	Native	Evergreen	Decay-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Wound to east side of trunk. Pruning wounds throughout the canopy. Light pole on west side of tree conflicting with canopy.	Adjoining street.	Retain
37	1	*Schinus areira*	**Peppercorn Tree**	*Schinus*	ANACARDIACEAE	7.0	3.0	3.0	1.0	5.0	0.48	0.54	5.76	2.55	Mature	Fair	Poor	Exotic	Evergreen	Cavity, Tip Dieback, Deadwood-Major, Epicormic Growth, Inclusions, Decay-Minor	Short (5-15 years)	Yes	Wilson Street	**Low**	Public street tree. Decay evident on multiple branches from old pruning wounds and at the base of the tree.	Adjoining street.	Retain
38	1	*Eucalyptus cladocalyx*	**Sugar Gum**	*Eucalyptus*	MYRTACEAE	9.5	7.0	2.0	6.0	8.0	0.57	0.68	6.84	2.81	Mature	Good	Poor	Native	Evergreen	Epicormic Growth, Lean-Major, Asymmetric Canopy	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Large pruning wound to north west for road clearance. Major lean to north-east with an asymmetric canopy. Surface roots throughout verge.	Adjoining street.	Retain
39	1	*Eucalyptus nicholii*	**Narrow-leaved Black Peppermint**	*Eucalyptus*	MYRTACEAE	7.5	3.0	2.0	2.0	4.0	0.25	0.33	3.00	2.08	Mature	Fair	Suppressed	Native	Evergreen	Asymmetric Canopy	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Asymmetric canopy to north-eastern side due to adjoining larger tree.	Adjoining street.	Retain
40	1	*Eucalyptus cladocalyx*	**Sugar Gum**	*Eucalyptus*	MYRTACEAE	14.5	11.0	5.0	8.0	9.0	0.70	0.90	8.40	3.17	Mature	Good	Average	Native	Evergreen	Epicormic Growth, Pest/Disease, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Potential canker or dysfunction on 1st order lower northern branch. Exposed roots conflicting and lifting kerb. Surface roots throughout verge.	Adjoining street.	Retain
41	1	*Lophostemon confertus*	**Brush Box**	*Lophostemon*	MYRTACEAE	9.0	5.0	4.0	4.0	4.0	0.55	0.63	6.60	2.73	Mature	Good	Good	Native	Evergreen	Decay-Minor	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Minor pruning wounds throughout canopy. Surface roots throughout verge.	Adjoining street.	Retain
42	1	*Grevillea robusta*	**Silky Oak**	*Grevillea*	PROTEACEAE	4.0	1.0	1.0	1.0	1.0	0.10	0.12	2.00	1.36	Young	Fair	Average	Invasive	Evergreen		Remove (<5 years)	Yes	Wilson Street	**V Low / Remove**	Public street tree. Newly planted. Potentially invasive species.	Potentially invasive	Remove
43	1	*Agonis flexuosa*	**Willow Myrtle**	*Agonis*	MYRTACEAE	4.0	1.0	0.5	1.0	3.0	0.16	0.25	2.00	1.85	Over-mature	Fair	Poor	Native	Evergreen	Asymmetric Canopy, Inclusions, Cavity, Lean-Major	Remove (<5 years)	Yes	Wilson Street	**V Low / Remove**	Public street tree. Very poor form and minimal foliage. Pruning wounds to north for road clearance.	Very poor tree	Remove
44	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	10.5	11.0	6.0	6.0	8.0	0.54	0.70	6.48	2.85	Mature	Good	Good	Exotic	Deciduous	Epicormic Growth, Lean-Minor, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots with roots growing in front of the kerb. Minor lean towards road. Surface roots throughout verge.	Adjoining street.	Retain
45	1	*Ficus benjamina*	**Weeping Fig**	*Ficus*	MORACEAE	6.0	3.0	3.0	3.0	3.0	0.21	0.28	2.52	1.94	Semi-mature	Good	Good	Exotic	Evergreen	Root Impacts	Long (>40 years)	Yes	Wilson Street	**Low**	Public street tree. Minor exposure of roots. Surface roots throughout verge. Potentially far too large growing for planted location. Would recommend removal.	Adjoining street.	Retain
46	1	*Melia azedarach*	**White Cedar**	*Melia*	MELIACEAE	4.0	0.5	4.0	2.0	1.0	0.20	0.27	2.40	1.91	Mature	Fair	Poor	Native	Deciduous	Asymmetric Canopy	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Pruning to east. Suppressed canopy to the east and very asymmetric to south-west.	Adjoining street.	Retain
47	1	*Melia azedarach*	**White Cedar**	*Melia*	MELIACEAE	4.0	1.0	2.0	1.0	2.0	0.19	0.26	2.28	1.88	Mature	Fair	Poor	Native	Deciduous	Decay-Minor, Cavity	Medium (15-40 years)	Yes	Wilson Street	**Low**	Public street tree. Pruning to west with small hollow 0.5m from ground level.	Adjoining street.	Retain
48	1	*Koelreuteria bipinnata*	**Chinese Rain Tree**	*Koelreuteria*	SAPINDACEAE	2.0	1.0	1.0	1.0	1.0	0.03	0.05	2.00	0.94	Young	Poor	Average	Exotic	Deciduous		Replaceable (Small/Young)	Yes	Wilson Street	**Low**	Public street tree. Newly planted, low value due to small and replaceable size.	Adjoining street.	Retain
49	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	10.5	9.0	6.0	6.0	8.0	0.62	0.72	7.44	2.88	Mature	Good	Good	Exotic	Deciduous	Epicormic Growth, Root Impacts, Lean-Minor	Long (>40 years)	Yes	Wilson Street	**High**	Public street tree. Exposed roots with roots growing over and along kerb. Minor lean towards road. .	Adjoining street.	Retain

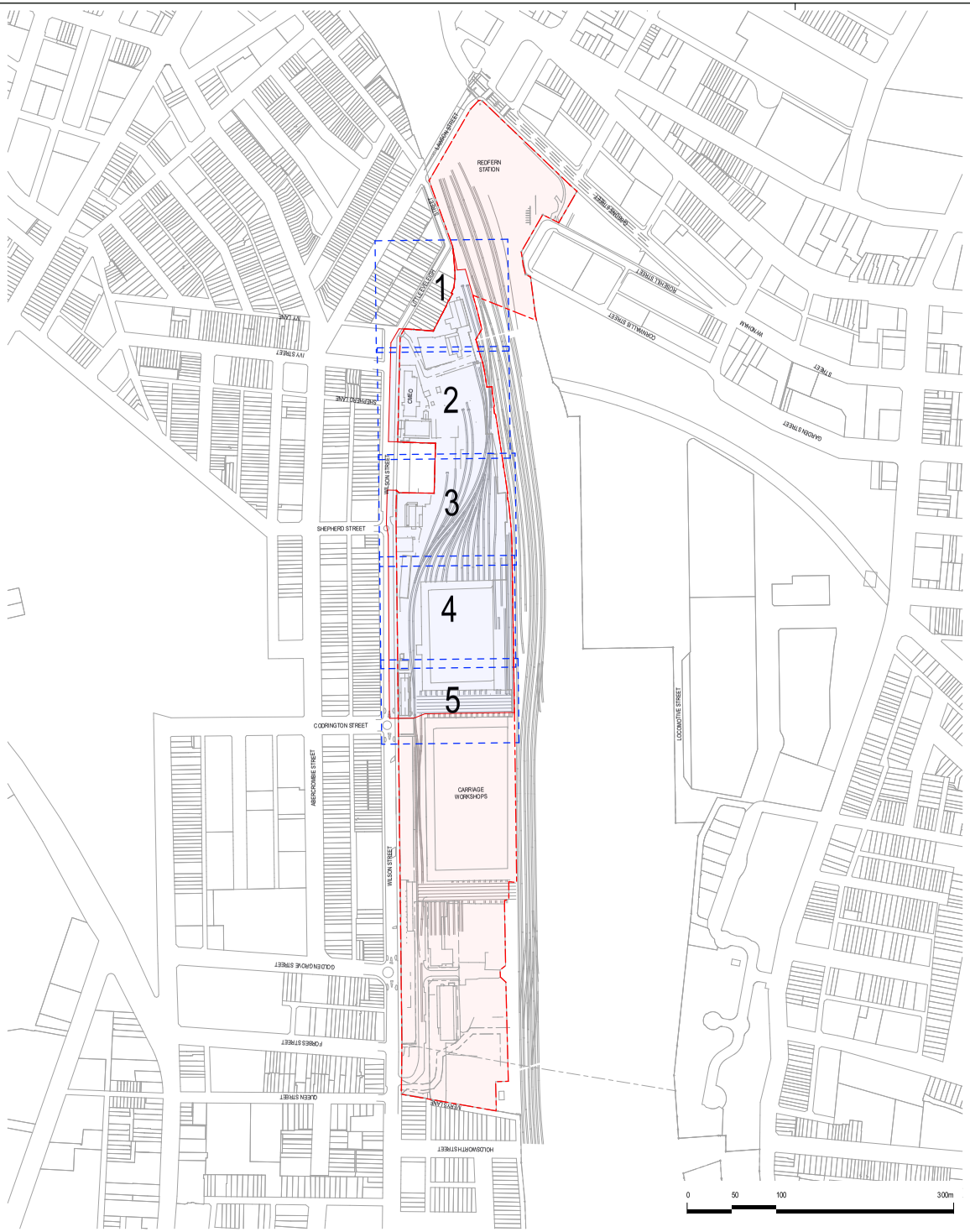
Tree ID	Trees in Group	Tree Species	Common Name	Genus	Family	Height (m)	Spread North (m)	Spread West (m)	Spread South (m)	Spread East (m)	Trunk Diameter Breast Height (dbh) (m)	Trunk Diameter at base (dgl) (m)	Nominal TPZ radius (m) 12xdbh (AS 4970)	Nominal SRZ radius (m) (AS 4970)	Age Class	Current Vigour	Current Form	Tree Origin	Tree Type	Noted Defects	SULE Rating	Street Tree	Precinct or Location	Retention Value	General Comments and Notes	Incursion and Impact	Recommendation
50	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	11.5	7.0	3.0	3.0	6.0	0.50	0.59	6.00	2.65	Mature	Good	Good	Exotic	Deciduous	Epicormic Growth, Root Impacts	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Exposed roots. Pruning to north for road clearance. Light pole and services pits on eastern.	Adjoining street.	Retain
51	1	*Corymbia citriodora*	**Lemon Scented Gum**	*Corymbia*	MYRTACEAE	11.0	8.0	6.0	6.0	4.0	0.51	0.62	6.12	2.71	Mature	Good	Average	Native	Evergreen	Branch Tearouts, Decay-Minor, Epicormic Growth	Long (>40 years)	Yes	Wilson Street	**Moderate**	Public street tree. Pruned for building clearance to the south-east. Branch tear-out on eastern side at 5m high from ground level.	Adjoining street.	Retain
201	1	*Eucalyptus microcorys*	**Tallowood**	*Eucalyptus*	MYRTACEAE	18.0	8.0	8.0	8.0	8.0	0.74	0.91	8.88	3.18	Mature	Fair	Average	Native	Evergreen	Tip Dieback	Long (>40 years)	No	Carriageworks	**Moderate**	Some tip dieback noted. Root area covered with geotextile marker layer and mulch.	Minimal impacts if sensitively designed around	Retain
202	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	17.0	8.0	8.0	8.0	6.0	0.82	0.96	9.84	3.25	Mature	Good	Average	Exotic	Deciduous		Long (>40 years)	No	Carriageworks	**Moderate**	Growing very near small retaining wall on road side. Numerous large branches pruned on road side. Root area covered with geotextile marker layer and mulch.	Minimal impacts if sensitively designed around	Retain
203	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	17.0	9.0	5.0	4.0	6.0	0.63	0.78	7.56	2.98	Mature	Fair	Average	Exotic	Deciduous		Long (>40 years)	No	Carriageworks	**Moderate**	Growing very near small retaining wall on road side. Numerous large branches pruned on road side and building side. Root area covered with geotextile marker layer and mulch.	Minimal impacts if sensitively designed around	Retain
204	1	*Eucalyptus microcorys*	**Tallowood**	*Eucalyptus*	MYRTACEAE	18.0	8.0	8.0	8.0	8.0	0.56	0.69	6.72	2.83	Mature	Good	Good	Native	Evergreen		Long (>40 years)	No	Carriageworks	**High**	Growing at apex of embankment. Root area covered with geotextile marker layer and mulch. One of the better and more prominent trees within the site.	Minimal impacts if sensitively designed around	Retain
205	1	*Phoenix canariensis*	**Canary Island Date Palm**	*Phoenix*	ARECACEAE	6.5	5.0	5.0	5.0	5.0	0.74	0.97	8.88	3.27	Mature	Good	Average	Exotic	Palm-SingleStem		Long (>40 years)	No	Carriageworks	**Low**	Ibis nesting in tree. Growing in steep embankment. Smaller specimen of the two growing in close proximity. May be self sown rather than intentionally planted.	Minimal impacts if sensitively designed around	Retain
206	1	*Phoenix canariensis*	**Canary Island Date Palm**	*Phoenix*	ARECACEAE	13.0	5.0	5.0	5.0	5.0	0.75	0.97	9.00	3.27	Mature	Good	Good	Exotic	Palm-SingleStem		Long (>40 years)	No	Carriageworks	**Moderate**	Ibis nesting in tree. Growing in steep embankment. Larger of the two closely growing specimens. Assumed to relate to the original landscaping treatments associated with the historic building complex.	Minimal impacts if sensitively designed around	Retain
207	1	*Cinnamomum camphora*	**Camphor Laurel**	*Cinnamomum*	LAURACEAE	16.5	4.0	5.0	7.0	6.0	0.67	0.84	8.04	3.08	Mature	Fair	Poor	Invasive	Evergreen	Asymmetric Canopy	Long (>40 years)	No	Carriageworks	**Moderate**	Poorly formed tree but likely to be of heritage significance due to association with Mechanical Engineers building and matching tree nearby. Large root and flare noted extending to south-west.	Minimal impacts if sensitively designed around	Retain
208	1	*Cinnamomum camphora*	**Camphor Laurel**	*Cinnamomum*	LAURACEAE	16.5	12.0	10.0	10.0	12.0	1.52	1.75	15.00	4.19	Mature	Good	Good	Invasive	Evergreen		Long (>40 years)	No	Carriageworks	**High**	Very large and well formed tree but likely to be of heritage significance due to association with Mechanical Engineers building and matching tree nearby.	Minimal impacts if sensitively designed around	Retain
209	1	*Phoenix canariensis*	**Canary Island Date Palm**	*Phoenix*	ARECACEAE	12.0	5.0	5.0	5.0	5.0	0.64	0.85	7.68	3.09	Mature	Good	Good	Exotic	Palm-SingleStem		Long (>40 years)	No	Carriageworks	**High**	Likely to be of heritage significance due to association with Mechanical Engineers building and matching tree nearby.	Minimal impacts if sensitively designed around	Retain
210	1	*Eucalyptus scoparia*	**Wallangarra White Gum**	*Eucalyptus*	MYRTACEAE	12.0	3.0	3.0	5.0	6.0	0.39	0.47	4.68	2.41	Mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Tip Dieback, Deadwood-Major	Short (5-15 years)	No	Carriageworks	**Low**	Poorly formed tree, little foliage. Numerous Celtis sinensis saplings growing around the base (not recorded).	Within development area	Remove
211	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	12.0	5.0	6.0	6.0	4.0	0.29	0.50	3.48	2.47	Semi-mature	Good	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
212	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.0	2.0	4.0	6.0	4.0	0.14	0.22	2.00	1.75	Semi-mature	Good	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
213	1	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	11.0	2.0	0.5	1.0	2.0	0.15	0.24	2.00	1.82	Over-mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Poor Taper	Remove (<5 years)	No	Carriageworks	**Low**	Numerous self sown Celtis sinensis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
214	1	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	12.0	2.0	0.5	0.5	2.0	0.17	0.26	2.04	1.88	Over-mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Poor Taper, Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**Low**	Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
215	1	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	12.0	2.0	0.5	0.5	2.0	0.20	0.32	2.40	2.05	Over-mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Poor Taper, Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**Low**	Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
216	1	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	12.0	2.0	0.5	0.5	2.0	0.21	0.35	2.52	2.13	Over-mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Poor Taper, Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**Low**	Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
217	1	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	12.0	2.0	0.5	0.5	2.0	0.23	0.36	2.76	2.15	Over-mature	Poor	Poor	Native	Evergreen	Asymmetric Canopy, Poor Taper, Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**Low**	Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
218	1	*Ligustrum lucidum*	**Broadleaf Privet**	*Ligustrum*	OLEACEAE	13.0	3.0	3.0	0.5	3.0	0.49	0.49	5.88	2.45	Mature	Fair	Poor	Weed	Evergreen	Asymmetric Canopy, Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Noxious weed. Should be removed. Assumed self sown. Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
219	1	*Grevillea robusta*	**Silky Oak**	*Grevillea*	PROTEACEAE	15.0	3.0	3.0	1.0	3.0	0.26	0.37	3.12	2.18	Semi-mature	Fair	Suppressed	Invasive	Evergreen	Asymmetric Canopy	Long (>40 years)	No	Carriageworks	**V Low / Remove**	Numerous self sown Celtis surrounding. Celtis not recorded but of similar height. Potentially self sown. Very little lower foliage.	Within development area	Remove
220	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	8.0	3.0	3.0	1.0	3.0	0.20	0.20	2.40	1.68	Over-mature	Fair	Suppressed	Native	Evergreen	Poor Taper, Co-dominant Stems, Asymmetric Canopy	Medium (15-40 years)	No	Carriageworks	**Low**	Typically multitrunked, sparse foliage. Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
221	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	7.0	2.0	2.0	1.0	2.0	0.12	0.12	2.00	1.36	Over-mature	Poor	Suppressed	Native	Evergreen	Asymmetric Canopy, Co-dominant Stems	Medium (15-40 years)	No	Carriageworks	**Low**	Typically multitrunked, sparse foliage. Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
222	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	8.0	2.0	3.0	1.0	2.0	0.28	0.28	3.36	1.94	Over-mature	Fair	Suppressed	Native	Evergreen	Poor Taper, Co-dominant Stems	Medium (15-40 years)	No	Carriageworks	**Low**	Typically multitrunked, sparse foliage. Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
223	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	9.0	2.0	2.0	2.0	1.0	0.19	0.19	2.28	1.65	Over-mature	Fair	Suppressed	Native	Evergreen	Poor Taper	Medium (15-40 years)	No	Carriageworks	**Low**	Sparse foliage. Numerous self sown Celtis surrounding. Celtis not recorded but of similar height.	Within development area	Remove
224	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	8.0	2.0	2.0	1.0	2.0	0.13	0.15	2.00	1.49	Semi-mature	Good	Poor	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Self sown, growing through gantry steps. Should remove.	Within development area	Remove
225	1	*Acacia parramattensis*	**Parramatta Wattle**	*Acacia*	FABACEAE	16.0	3.0	6.0	6.0	7.0	0.37	0.57	4.44	2.61	Mature	Good	Average	Endemic	Evergreen	Deadwood-Minor, Lean-Major, Asymmetric Canopy, Pest/Disease	Short (5-15 years)	No	Carriageworks	**Low**	Major lean to south-east away from building. Some evidence of borers noted.	Within development area	Remove
226	1	*Eucalyptus pilularis ?*	**Blackbutt**	*Eucalyptus*	MYRTACEAE	17.0	4.0	6.0	6.0	4.0	0.36	0.48	4.32	2.43	Mature	Moribund	Poor	Endemic	Evergreen	Tip Dieback, Deadwood-Major	Short (5-15 years)	No	Carriageworks	**V Low / Remove**	Growing within a rubber car tyre at its base which has now girdled stem. Unlikely to ever recover, even if tyre cut free. Very poor condition.	Within development area	Remove
227	1	*Acacia parramattensis*	**Parramatta Wattle**	*Acacia*	FABACEAE	13.0	3.0	6.0	6.0	7.0	0.32	0.40	3.84	2.25	Mature	Good	Average	Endemic	Evergreen	Lean-Major, Asymmetric Canopy, Co-dominant Stems	Short (5-15 years)	No	Carriageworks	**Low**	Major lean to south-east away from building and other adjoining trees.	Within development area	Remove
228	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.5	4.0	4.0	4.0	4.0	0.55	0.55	6.60	2.57	Semi-mature	Good	Poor	Invasive	Deciduous	Co-dominant Stems, Inclusions	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
229	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.5	4.0	4.0	4.0	4.0	0.20	0.35	2.40	2.13	Semi-mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
230	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	4.0	4.0	4.0	4.0	0.31	0.32	3.72	2.05	Semi-mature	Fair	Average	Invasive	Deciduous	Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
231	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	4.0	4.0	4.0	4.0	0.14	0.22	2.00	1.75	Semi-mature	Fair	Average	Invasive	Deciduous	Co-dominant Stems	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
232	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	4.0	4.0	4.0	4.0	0.34	0.34	4.08	2.10	Semi-mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed.	Within development area	Remove
233	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	10.0	4.0	4.0	4.0	4.0	0.40	0.40	4.80	2.25	Semi-mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Invasive weed, should be removed. Growing hard against building, in corner of building.	Within development area	Remove
234	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	6.5	3.0	3.0	3.0	3.0	0.25	0.26	3.00	1.88	Mature	Good	Poor	Native	Evergreen	Co-dominant Stems, Inclusions	Medium (15-40 years)	No	Carriageworks	**Low**	Co-dominant stems with a serious bark branch inclusion.	Within development area	Remove
235	2	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	4.0	3.0	3.0	4.0	0.16	0.22	2.00	1.75	Semi-mature	Good	Poor	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Group of 2 trees. Self sown. Two closely spaced and inter grown. Hard against adjoining retaining wall. Invasive weed, should be removed.	Within development area	Remove
236	1	*Eucalyptus punctata*	**Grey Gum**	*Eucalyptus*	MYRTACEAE	13.0	3.0	3.0	3.0	3.0	0.21	0.30	2.52	2.00	Semi-mature	Fair	Poor	Endemic	Evergreen	Branch Tearouts	Medium (15-40 years)	No	Carriageworks	**Low**	Assumed self sown. Very close against rear of retaining wall. Major trunk tear-out from what appears to be a previously included stem.	Within development area	Remove
237	1	*Eucalyptus punctata*	**Grey Gum**	*Eucalyptus*	MYRTACEAE	11.0	6.0	3.0	6.0	4.0	0.29	0.33	3.48	2.08	Mature	Fair	Poor	Endemic	Evergreen	Branch Tearouts, Deadwood-Minor, Budgies	Medium (15-40 years)	No	Carriageworks	**Low**	Major dysfunction noted in cambial tissue at base of tree. Branch tearout and loss of leader at 2.5m. Generally poorly developed tree.	Within development area	Remove
238	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	8.0	4.0	4.0	4.0	4.0	0.22	0.31	2.64	2.02	Semi-mature	Good	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Self sown weed. Two closely spaced and inter grown. Invasive weed, should be removed.	Within development area	Remove
239	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	3.0	3.0	0.5	2.0	0.16	0.18	2.00	1.61	Semi-mature	Good	Average	Invasive	Deciduous	Asymmetric Canopy	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Self sown weed. Two closely spaced and inter grown. Invasive weed, should be removed.	Within development area	Remove
240	1	*Eucalyptus punctata*	**Grey Gum**	*Eucalyptus*	MYRTACEAE	7.0	2.0	2.0	2.0	2.0	0.08	0.11	2.00	1.31	Young	Good	Average	Endemic	Evergreen	Poor Taper, Root Impacts	Replaceable (Small/Young)	No	Carriageworks	**Low**	Self sown growing out of bank. Growing beneath larger trees. Similar smaller sapling nearby not recorded.	Within development area	Remove
241	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	10.0	7.0	6.0	4.0	2.0	0.42	0.79	5.04	3.00	Mature	Good	Average	Native	Evergreen	Tip Dieback, Asymmetric Canopy, Root Impacts	Medium (15-40 years)	No	Carriageworks	**Low**	Growing very close to adjoining building resulting in asymmetric canopy development. Intergrowing with self sown Celtis.	Within development area	Remove
242	3	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	10.5	4.0	3.0	3.0	4.0	0.16	0.19	2.00	1.65	Semi-mature	Fair	Poor	Invasive	Deciduous	Asymmetric Canopy	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Group of 3 trees. Three closely spaced and intergrown specimens around planted Callistemon. Hard against building wall. Largest one measured. Invasive weed, should be removed.	Within development area	Remove
243	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	8.5	4.0	5.0	5.0	4.0	0.26	0.39	3.12	2.23	Over-mature	Poor	Poor	Invasive	Deciduous	Tip Dieback	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Poor condition, extensive dieback. Invasive weed, should be removed.	Within development area	Remove
244	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	7.0	4.0	5.0	5.0	4.0	0.10	0.12	2.00	1.36	Young	Fair	Poor	Invasive	Deciduous	Tip Dieback	Remove (<5 years)	No	Carriageworks	**V Low / Remove**	Small self sown tree against building. Invasive weed, should be removed.	Within development area	Remove
245	1	*Malus sp.*	**Apple or Crabapple**	*Malus*	ROSACEAE	7.0	4.0	5.0	5.0	4.0	0.28	0.34	3.36	2.10	Mature	Good	Average	Exotic	Deciduous		Medium (15-40 years)	No	Carriageworks	**Moderate**	Apple or Crabapple cultivar. Assumed to be deliberately planted by previous railway workshop workers. Reasonable condition. Foliage to ground, other smaller specimens nearby but not recorded due to small sizes.	Within development area	Remove
246	1	*Ficus rubiginosa*	**Port Jackson Fig**	*Ficus*	MORACEAE	6.0	4.0	5.0	5.0	4.0	0.28	0.32	3.36	2.05	Young	Good	Average	Endemic	Evergreen		Long (>40 years)	No	Carriageworks	**Moderate**	Assumed to be self sown. Reasonable form and condition. Could be transplanted with risk.	Within development area	Remove

Tree ID	Trees in Group	Tree Species	Common Name	Genus	Family	Height (m)	Spread North (m)	Spread West (m)	Spread South (m)	Spread East (m)	Trunk Diameter Breast Height (dbh) (m)	Trunk Diameter at base (dgl) (m)	Nominal TPZ radius (m) 12xdbh (AS 4970)	Nominal SRZ radius (m) (AS 4970)	Age Class	Current Vigour	Current Form	Tree Origin	Tree Type	Noted Defects	SULE Rating	Street Tree	Precinct or Location	Retention Value	General Comments and Notes	Incursion and Impact	Recommendation
247	1	*Sapium sebiferum*	**Chinese Tallow Tree**	*Sapium*	SAPINDACEAE	6.0	4.0	5.0	5.0	4.0	0.12	0.27	2.00	1.91	Semi-mature	Fair	Average	Exotic	Deciduous	Root Impacts	Medium (15-40 years)	No	Carriageworks	Low	Growing out of crack in kerb.	Within development area	Remove
248	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.5	2.0	5.0	6.0	3.0	0.32	0.46	3.84	2.39	Mature	Good	Average	Invasive	Deciduous	Asymmetric Canopy	Long (>40 years)	No	Carriageworks	V Low / Remove	Self sown growing next to railway buffer within tracks. Visually prominent from active railway corridor. Very asymmetric canopy. Invasive weed, should be removed.	Within development area	Remove
249	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	11.0	8.0	7.0	6.0	4.0	0.50	0.64	6.00	2.74	Mature	Good	Good	Invasive	Deciduous		Long (>40 years)	No	Carriageworks	Moderate	Visually significant and well formed tree next to active station platform. For this reason would recomend that this be the only Celtis potentially retained in the short term until other more suitable landscaping could be provided.	Within development area	Remove
250	1	*Cupressus macrocarpa*	**Monterey Cypress**	*Cupressus*	CUPRESSACEAE	8.5	4.0	1.5	1.0	4.0	0.27	0.27	3.24	1.91	Semi-mature	Good	Poor	Exotic	Conifer	Asymmetric Canopy	Long (>40 years)	No	Carriageworks	Low	Poor location and unsympathetic pruning. Minimal long term prospects for attaining a worthwhile tree.	Within development area	Remove
251	1	*Eriobotrya japonica*	**Loquat**	*Eriobotrya*	ROSACEAE	8.5	4.0	1.5	1.0	4.0	0.29	0.33	3.48	2.08	Mature	Good	Average	Exotic	Evergreen		Long (>40 years)	No	Carriageworks	Low	Small exotic fruit tree, probably self sown or garden escape.	Within development area	Remove
252	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	11.0	8.0	7.0	6.0	4.0	0.52	0.75	6.24	2.93	Mature	Good	Average	Invasive	Deciduous		Long (>40 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
253	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	13.0	6.0	10.0	6.0	4.0	0.40	0.60	4.80	2.67	Mature	Good	Average	Invasive	Deciduous		Long (>40 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
254	1	*Araucaria heterophylla*	**Norfolk Island Pine**	*Araucaria*	ARAUCARIACEAE	9.0	3.0	3.0	2.0	2.0	0.15	0.18	2.00	1.61	Semi-mature	Fair	Poor	Exotic	Conifer	Poor Taper	Long (>40 years)	No	Carriageworks	Low	Generally suppressed form due to surrounding copse of self sown invasive species. Potentially a garden escape or unwanted pot plant planted by neighbours.	Within development area	Remove
255	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	13.0	6.0	10.0	6.0	4.0	0.40	0.60	4.80	2.67	Mature	Good	Average	Invasive	Deciduous		Long (>40 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
256	2	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	8.0	0.5	1.5	9.0	4.0	0.18	0.20	2.16	1.68	Semi-mature	Good	Suppressed	Invasive	Deciduous	Asymmetric Canopy, Lean-Major	Remove (<5 years)	No	Carriageworks	V Low / Remove	Group of 2 trees. Suppressed, asymmetric and vine covered. Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
257	1	*Callistemon viminalis cv.*	**Weeping Bottlebrush**	*Callistemon*	MYRTACEAE	7.5	0.5	0.5	7.0	3.0	0.12	0.18	2.00	1.61	Over-mature	Poor	Poor	Native	Evergreen		Short (5-15 years)	No	Carriageworks	Low	Poor condition and form.	Within development area	Remove
258	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	8.0	0.5	1.5	6.0	3.0	0.09	0.10	2.00	1.26	Semi-mature	Good	Suppressed	Invasive	Deciduous	Asymmetric Canopy, Lean-Major	Remove (<5 years)	No	Carriageworks	V Low / Remove	Suppressed, asymmetric and vine covered. Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
259	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.0	0.5	1.5	6.0	4.0	0.07	0.09	2.00	1.20	Semi-mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy, Lean-Major	Remove (<5 years)	No	Carriageworks	V Low / Remove	Suppressed, asymmetric. Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
260	2	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	11.0	2.0	1.5	6.0	8.0	0.60	0.65	7.20	2.76	Semi-mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy, Lean-Minor	Remove (<5 years)	No	Carriageworks	V Low / Remove	Group of 2 trees. Suppressed, asymmetric. Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
261	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	12.0	5.0	8.0	9.0	7.0	0.70	0.80	8.40	3.01	Semi-mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	V Low / Remove	One of the large trees within a copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
262	2	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	12.0	5.0	8.0	9.0	7.0	0.27	0.30	3.24	2.00	Semi-mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy	Remove (<5 years)	No	Carriageworks	V Low / Remove	Group of 2 trees. Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
263	1	*Ficus rubiginosa*	**Port Jackson Fig**	*Ficus*	MORACEAE	12.0	5.0	8.0	9.0	7.0	1.20	1.50	14.40	3.92	Mature	Good	Average	Native	Evergreen		Long (>40 years)	No	Carriageworks	Moderate	Growing out of and around multi-levelled rubble/rock wall. Assumed to be self sown. Very multi trunked and only average form but potentially worthy of retention if possible.	Minimal impacts if sensitively designed around	Retain
264	1	*Eriobotrya japonica*	**Loquat**	*Eriobotrya*	ROSACEAE	8.0	5.0	8.0	9.0	7.0	0.20	0.30	2.40	2.00	Mature	Good	Poor	Exotic	Evergreen	Asymmetric Canopy Lean-Major	Medium (15-40 years)	No	Carriageworks	Low	Major lean and asymmetric canopy.	Within development area	Remove
265	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	12.0	1.0	1.0	5.0	5.0	0.10	0.13	2.00	1.40	Semi-mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy Poor Taper	Remove (<5 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
266	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	10.0	5.0	5.0	7.0	1.0	0.20	0.30	2.40	2.00	Semi-mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy	Remove (<5 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
267	1	*Jacaranda mimosifolia*	**Jacaranda**	*Jacaranda*	BIGNONIACEAE	14.0	9.0	8.0	6.0	5.0	0.50	0.70	6.00	2.85	Mature	Fair	Average	Exotic	Deciduous	Co-dominant Stems	Long (>40 years)	No	Carriageworks	Moderate	Generally a good specimen although not much of the lower canopy foliage still present. Tree could look quite misshapen when all surrounding weeds are removed.	Minimal impacts if sensitively designed around	Retain
268	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	10.5	5.0	5.0	8.0	8.0	0.36	0.50	4.32	2.47	Mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Invasive weed, should be removed.	Within development area	Remove
269	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.0	0.5	1.0	5.0	5.0	0.18	0.30	2.16	2.00	Mature	Fair	Suppressed	Invasive	Deciduous	Asymmetric Canopy	Remove (<5 years)	No	Carriageworks	V Low / Remove	Copse of self sown invasive species. Growing out of side of building/ retaining wall. Invasive weed, should be removed.	Within development area	Remove
270	1	*Casuarina cunninghamiana*	**River She-Oak**	*Casuarina*	CASUARINACEAE	16.0	4.0	5.0	7.0	6.0	0.60	0.70	7.20	2.85	Mature	Fair	Good	Endemic	Evergreen	Tip Dieback, Deadwood-Minor	Long (>40 years)	No	Carriageworks	Low	Substantial tip die back noted in upper canopy.	Within development area	Remove
271	1	*Ficus rubiginosa*	**Port Jackson Fig**	*Ficus*	MORACEAE	8.0	4.0	5.0	4.0	6.0	0.60	0.70	7.20	2.85	Semi-mature	Good	Average	Native	Evergreen		Long (>40 years)	No	Carriageworks	Moderate	Assumed to be self sown due to position, growing out of rubble walling adjacent boundary fence.	Minimal impacts if sensitively designed around	Retain
272	1	*Cupressus macrocarpa*	**Monterey Cypress**	*Cupressus*	CUPRESSACEAE	12.0	5.0	5.0	3.0	3.0	0.30	0.60	3.60	2.67	Mature	Good	Average	Exotic	Conifer	Lean-Minor	Long (>40 years)	No	Carriageworks	Moderate	Tree located on neighbouring property, hence retention value of moderate. Very close to boundary on edge of embankment.	Minimal impacts if sensitively designed around	Retain
273	22	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.0	3.0	2.0	3.0	3.0	0.20	0.25	2.40	1.85	Semi-mature	Fair	Poor	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	V Low / Remove	Group of 22 trees. Extensive and dense thicket of trees and saplings and other intergrowing weeds. Minimal value. Plan positions estimated and indicative only. Invasive weeds, should be removed.	Within development area	Remove
274	6	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	9.5	3.0	2.0	3.0	3.0	0.50	0.55	6.00	2.57	Semi-mature	Fair	Poor	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	V Low / Remove	Group of 6 trees. Dense thicket of trees and saplings and other weeds growing adjacent driveway. Invasive weeds, should be removed.	Within development area	Remove
275	1	*Platanus x acerifolia*	**London Plane**	*Platanus*	PLATANACEAE	9.5	3.0	2.0	4.0	5.0	0.32	0.40	3.84	2.25	Semi-mature	Fair	Average	Exotic	Deciduous	Asymmetric Canopy, Tip Dieback	Long (>40 years)	No	Carriageworks	Low	Asymmetric canopy development, probably due to previous nearby trees that are now removed.	Within development area	Remove
276	3	*Melaleuca bracteata*	**Black Tea-Tree**	*Melaleuca*	MYRTACEAE	8.0	3.0	2.0	4.0	5.0	0.35	0.40	4.20	2.25	Mature	Fair	Poor	Native	Evergreen	Co-dominant Stems	Medium (15-40 years)	No	Carriageworks	Low	Group of 3 trees. Group of three specimens that have been historically lopped to ground level. Multi-stemmed from base. Very close to boundary and adjoining property. Long term value questionable, although healthy and vigourous.	Within development area	Remove
277	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	9.0	3.0	3.0	3.0	3.0	0.15	0.18	2.00	1.61	Semi-mature	Good	Good	Native	Evergreen	Root Impacts	Long (>40 years)	No	Carriageworks	Moderate	Small intentionally planted trees growing adjacent to large level change / informal non-retained embankment.	Within development area	Remove
278	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	5.0	3.0	3.0	3.0	3.0	0.09	0.10	2.00	1.26	Semi-mature	Poor	Poor	Endemic	Evergreen	Root Impacts, Co-dominant Stems	Short (5-15 years)	No	Carriageworks	V Low / Remove	Small intentionally planted trees growing adjacent to large level change / informal non-retained embankment. Poor condition.	Within development area	Remove
279	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	6.5	2.0	0.5	2.0	3.0	0.07	0.10	2.00	1.26	Semi-mature	Poor	Poor	Endemic	Evergreen	Root Impacts, Asymmetric Canopy	Long (>40 years)	No	Carriageworks	Low	Small intentionally planted trees growing adjacent to large level change / informal non-retained embankment.	Within development area	Remove
280	1	*Syagrus romanzoffiana*	**Queen Palm**	*Syagrus*	ARECACEAE	7.5	2.0	2.0	2.0	2.0	0.20	0.20	2.40	1.68	Mature	Fair	Average	Exotic	Palm-SingleStem		Long (>40 years)	No	Carriageworks	V Low / Remove	Minimal landscape value.	Within development area	Remove
281	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	8.5	3.0	1.0	2.0	3.0	0.18	0.28	2.16	1.94	Semi-mature	Fair	Average	Endemic	Evergreen	Root Impacts	Long (>40 years)	No	Carriageworks	Low	Small intentionally planted trees growing adjacent to large level change / informal non-retained embankment.	Within development area	Remove
282	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	8.5	3.0	1.0	2.0	3.0	0.12	0.16	2.00	1.53	Semi-mature	Fair	Average	Endemic	Evergreen	Root Impacts	Long (>40 years)	No	Carriageworks	Low	Small intentionally planted trees growing adjacent to large level change / informal non-retained embankment.	Within development area	Remove
283	1	*Eucalyptus saligna*	**Sydney Blue Gum**	*Eucalyptus*	MYRTACEAE	8.5	3.0	1.0	2.0	3.0	0.11	0.15	2.00	1.49	Semi-mature	Fair	Average	Endemic	Evergreen	Root Impacts	Long (>40 years)	No	Carriageworks	Low	Assumed self sown due to position growing within large level change / informal non-retained embankment.	Within development area	Remove
284	1	*Sapium sebiferum*	**Chinese Tallow Tree**	*Sapium*	SAPINDACEAE	8.0	2.0	2.0	2.0	2.0	0.12	0.15	2.00	1.49	Young	Fair	Average	Exotic	Deciduous		Remove (<5 years)	No	Carriageworks	Low	Assumed self sown.	Within development area	Remove
287	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	6.5	3.0	3.0	3.0	3.0	0.15	0.20	2.00	1.68	Semi-mature	Fair	Average	Invasive	Deciduous		Remove (<5 years)	No	Carriageworks	V Low / Remove	Assumed self sown. No direct access available for detailed assessment due to location. Invasive weed, should be removed.	Within development area	Remove
288	1	*Celtis sinensis*	**Chinese Hackberry**	*Celtis*	ULMACAEAE	12.0	5.0	0.5	5.0	6.0	0.35	0.42	4.20	2.30	Mature	Good	Average	Invasive	Deciduous	Asymmetric Canopy	Long (>40 years)	No	Carriageworks	V Low / Remove	Growing in side passage of adjoining building, overhanging railway. Very asymmetric canopy.	Within development area	Remove
289	1	*Hymenosporum flavum*	**Native Frangipani**	*Hymenosporum*	PITTOSPORACEAE	7.0	2.0	2.5	2.5	1.0	0.15	0.20	2.00	1.68	Mature	Fair	Poor	Native	Evergreen	Asymmetric Canopy	Long (>40 years)	Yes	Little Eveleigh Street	Low	Public street tree. Poor condition and form.	Adjoining street.	Retain
290	1	*Hymenosporum flavum*	**Native Frangipani**	*Hymenosporum*	PITTOSPORACEAE	7.0	2.5	2.5	2.5	2.0	0.16	0.19	2.00	1.65	Mature	Fair	Average	Native	Evergreen		Long (>40 years)	Yes	Little Eveleigh Street	Moderate	Public street tree.	Adjoining street.	Retain

6.2 Schedule of Proposed Tree Species

Family	Genus	Species	Common Name	Potential Height Reached in Street	Ultimate Size Class	Typical Ultimate Canopy Extent (Canopy Cover)	Native/ Exotic	Evergreen/ Deciduous
CIVIC TREES								
PODOCARPACEAE	*Afrocarpus*	*falcatus*	**Outeniqua Yellow Wood**	20-25m	Civic	314m2	Exotic	Evergreen
ARAUCARIACEAE	*Agathis*	*robusta*	**Queensland Kauri**	20-25m	Civic	175m2	Native	Evergreen
ARAUCARIACEAE	*Araucaria*	*bidwillii*	**Bunya Pine**	20-28m	Civic	78m2	Native	Evergreen
ARAUCARIACEAE	*Araucaria*	*columnaris*	**Cook Pine**	20-28m	Civic	78m2	Exotic	Evergreen
ARAUCARIACEAE	*Araucaria*	*cunninghamii*	**Hoop Pine**	20-28m	Civic	78m2	Native	Evergreen
ARAUCARIACEAE	*Araucaria*	*heterophylla*	**Norfolk Island Pine**	20-28m	Civic	175m2	Exotic	Evergreen
MYRTACEAE	*Eucalyptus*	*pilularis*	**Blackbutt**	20-25m	Civic	314m2	Endemic	Evergreen
MYRTACEAE	*Eucalyptus*	*saligna*	**Sydney Bluegum**	20-28m	Civic	314m2	Endemic	Evergreen
MORACEAE	*Ficus*	*macrophylla*	**Morton Bay Fig**	20-25m	Civic	314m2	Native	Evergreen
MORACEAE	*Ficus*	*microcarpa var. hillii*	**Hills Weeping Fig**	20-25m	Civic	314m2	Native	Evergreen
MORACEAE	*Ficus*	*obliqua*	**Small Leaf Fig**	20-25m	Civic	314m2	Native	Evergreen
LARGE TREES								
MYRTACEAE	*Angophora*	*costata*	**Smooth-barked Apple**	12-20m	Large	175m2	Endemic	Evergreen
MYRTACEAE	*Angophora*	*floribunda*	**Rough-barked Apple**	12-20m	Large	175m2	Endemic	Evergreen
FABACEAE	*Castanospermum*	*australe*	**Black Bean**	15-18m	Large	175m2	Native	Evergreen
MYRTACEAE	*Corymbia*	*maculata*	**Spotted Gum**	18-25m	Large	175m2	Native	Evergreen
MYRTACEAE	*Eucalyptus*	*microcorys*	**Tallowood**	20-25m	Large	175m2	Native	Evergreen
MYRTACEAE	*Eucalyptus*	*paniculata*	**Grey Ironbark**	20-25m	Large	175m2	Endemic	Evergreen
MORACEAE	*Ficus*	*rubiginosa*	**Port Jackson Fig**	15-20m	Large	175m2	Endemic	Evergreen
PLATANACEAE	*Platanus*	*x acerifolia 'Bloodgood'*	**London Plane**	18-25m	Large	175m2	Exotic	Deciduous
PODOCARPACEAE	*Podocarpus*	*elatus*	**Illawara Plum Pine**	18-25m	Large	175m2	Native	Evergreen
MYRTACEAE	*Syncarpia*	*glomulifera*	**Turpentine**	18-25m	Large	175m2	Endemic	Deciduous
ULMACAEAE	*Ulmus*	*parvifolia 'Todd'*	**Chinese Elm**	10-12m	Large	175m2	Exotic	Deciduous
MEDIUM TREES								
MYRTACEAE	*Acmena*	*smithii*	**Creek Lilly-Pilly**	10-15m	Medium	78m2	Endemic	Evergreen
SAPINDACEAE	*Alectryon*	*tomentosus*	**Woolly Rambutan**	10-15m	Medium	78m2	Native	Evergreen
MALVACEAE	*Brachychiton*	*acerifolius*	**Illawarra Flame Tree**	15-20m	Medium	78m2	Native	Deciduous
MALVACEAE	*Brachychiton*	*discolor*	**Queensland Lacebark**	15-20m	Medium	78m2	Native	Deciduous
FABACEAE	*Caesalpinia*	*ferrea*	**Leopardwood**	10-15m	Medium	78m2	Exotic	Deciduous
MYRTACEAE	*Corymbia*	*eximia*	**Yellow Bloodwood**	10-18m	Medium	78m2	Native	Evergreen
MYRTACEAE	*Corymbia*	*gummifera*	**Red Bloodwood**	10-18m	Medium	78m2	Native	Evergreen
MYRTACEAE	*Eucalyptus*	*botryoides*	**Bangalay**	18-25m	Medium	78m2	Endemic	Evergreen
MYRTACEAE	*Eucalyptus*	*haemastoma*	**Scribbly Gum**	10-15m	Medium	78m2	Endemic	Evergreen
MYRTACEAE	*Eucalyptus*	*punctata*	**Grey Gum**	18-25m	Medium	78m2	Native	Evergreen
MYRTACEAE	*Eucalyptus*	*robusta*	**Swamp Mahogany**	10-15m	Medium	78m2	Endemic	Evergreen
RUTACEAE	*Flindersia*	*australis*	**Crows Ash**	15-20m	Medium	78m2	Native	Evergreen
OLEACEAE	*Fraxinus*	*pennsylvanica*	**Red Ash**	12-18m	Medium	78m2	Exotic	Deciduous
EUPHORBIACEAE	*Glochidion*	*ferdinandi*	**Cheese Tree**	8-12m	Medium	78m2	Endemic	Evergreen
SAPINDACEAE	*Harpullia*	*pendula*	**Tulipwood**	8-12m	Medium	78m2	Native	Evergreen
BIGNONIACEAE	*Jacaranda*	*mimosifolia*	**Jacaranda**	10-15m	Medium	78m2	Exotic	Deciduous
SAPINDACEAE	*Koelreutaria*	*bipinnata*	**Chinese Rain Tree**	10-15m	Medium	78m2	Exotic	Deciduous
MYRTACEAE	*Lophostemon*	*confertus*	**Brush Box**	20-25m	Medium	78m2	Native	Evergreen
MYRTACEAE	*Melaleuca*	*leucadendra*	**Weeping Paperbark**	15-18m	Medium	78m2	Native	Evergreen
MYRTACEAE	*Melaleuca*	*quinquinervia*	**Broad-Leaf Paperbark**	18-20m	Medium	78m2	Endemic	Evergreen
FAGACEAE	*Quercus*	*Ilex*	**Holm Oak**	12-15m	Medium	78m2	Exotic	Evergreen
FABACEAE	*Robinia*	*pseudoacacia 'Frisia'*	**Black Locust**	10-12m	Medium	78m2	Exotic	Deciduous
EUPHORBIACEAE	*Sapium*	*sebiferum*	**Chinese Tallow Tree**	10-12m	Medium	78m2	Exotic	Deciduous
MYRTACEAE	*Syzygium*	*paniculatum*	**Brush Cherry**	8-12m	Medium	78m2	Native	Evergreen
BIGNONIACEAE	*Tabebuia*	*impetiginosa*	**Pink Trumpet Tree**	10-15m	Medium	78m2	Exotic	Deciduous
MYRTACEAE	*Waterhousea*	*floribunda 'Green Avenue'*	**Weeping Lilly Pilly**	18-25m	Medium	78m2	Native	Evergreen
ULMACAEAE	*Zelkova*	*serrata 'Green Vase'*	**Japanese Zelkova**	10-12m	Medium	78m2	Exotic	Deciduous
SMALL TREES								
FABACEAE	*Acacia*	*binervia*	**Coastal Myall**	8-12m	Small	38m2	Endemic	Evergreen
MYRTACEAE	*Angophora*	*hispida*	**Dwarf Apple**	5-7m	Small	38m2	Endemic	Evergreen
MYRTACEAE	*Backhousia*	*citriodora*	**Lemon-scented Myrtle**	7-10m	Small	38m2	Native	Evergreen
PROTEACEAE	*Banksia*	*integrifolia*	**Coast Banksia**	7-10m	Small	38m2	Endemic	Evergreen
PROTEACEAE	*Buckinghamia*	*celsissima*	**Ivory Curl Flower**	7-10m	Small	38m2	Native	Evergreen
MYRTACEAE	*Callistemon*	*viminalis cv.*	**Bottlebrush**	7-10m	Small	38m2	Native	Evergreen
PROTEACEAE	*Macadamia*	*integrifolia*	**Macadamia**	7-10m	Small	38m2	Native	Evergreen
SAPINDACEAE	*Cupaniopsis*	*anacardioides*	**Tuckeroo**	8-15m	Small	38m2	Endemic	Evergreen
ELAEOCARPACEAE	*Elaeocarpus*	*eumundi*	**Eumundi Quondong**	10-20m	Small	38m2	Native	Evergreen
ELAEOCARPACEAE	*Elaeocarpus*	*reticulatus*	**Blue Berry Ash**	8-12m	Small	38m2	Endemic	Evergreen
THEACEAE	*Gordonia*	*axillaris*	**Gordonia**	5-8m	Small	38m2	Exotic	Evergreen
SAPINDACEAE	*Guioa*	*semiglauca*	**Wild Quince**	8-10m	Small	38m2	Native	Evergreen
MALVACEAE	*Hibiscus*	*tiliaceous*	**Coast Cottonwood**	8-10m	Small	38m2	Native	Evergreen
SAPINDACEAE	*Koelreutaria*	*paniculata*	**Golden Rain Tree**	7-9m	Small	38m2	Exotic	Deciduous
LYTHRACEAE	*Lagerstroemia*	*indica cv.*	**Crepe Myrtle**	8-10m	Small	38m2	Exotic	Deciduous
MYRTACEAE	*Leptospermum*	*petersonii*	**Lemon-scented Tea Tree**	7-10m	Small	38m2	Native	Evergreen
ARECACEAE	*Livistona*	*australis*	**Cabbage Tree Palm**	15-20m	Small	38m2	Endemic	Evergreen
MAGNOLIACEAE	*Magnolia*	*grandiflora 'Exmouth'*	**Bull-bay Magnolia**	12-15m	Small	38m2	Exotic	Evergreen
MYRTACEAE	*Melaleuca*	*styphelioides*	**Prickly Paperbark**	8-12m	Small	38m2	Endemic	Evergreen
ARALIACEAE	*Polyscias*	*elegans*	**Celerywood**	8-12m	Small	38m2	Native	Evergreen
ROSACEAE	*Pyrus*	*calleryana 'Chanticleer'*	**Callery Pear**	6-8m	Small	38m2	Exotic	Deciduous
PROTEACEAE	*Stenocarpus*	*sinuatus*	**Firewheel Tree**	8-12m	Small	38m2	Native	Evergreen
MYRTACEAE	*Syzygium*	*leuhmannii*	**Riberry**	8-12m	Small	38m2	Native	Evergreen
MYRTACEAE	*Tristaniopsis*	*laurina*	**Water Gum**	7-10m	Small	38m2	Native	Evergreen
MYRTACEAE	*Tristaniopsis*	*laurina 'Luscious'*	**Glossy-Leaved Water Gum**	7-10m	Small	38m2	Native	Evergreen
ARECACEAE	*Washingtonia*	*robusta*	**Mexican Fan Palm**	20-25m	Small	38m2	Exotic	Evergreen
SALICACEAE	*Xylosma*	*senticosum*	**Xylosma**	6-10m	Small	38m2	Exotic	Evergreen

6.3 Detailed Plans of Proposed Trees to be Retained and Removed



Redfern North Eveleigh, UFS - Existing Tree Assessment Schedule

Tree ID	Trees in Group	Tree Species	Common Name	Trunk Diameter Breast Height (dbh cm)	Trunk Diameter at base (dgl) (m)	Nominal TPZ Radius (m) (Dedh. AS 4970)	Nominal SRZ radius (m) (AS 4970)	Retention Value	Recommendation
1	1	Platanus x acerifolia	London Plane	0.65	0.78	7.80	3.09	Moderate	Retain
2	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
3	1	Lophostemon confertus	Brush Box	0.60	0.60	6.00	2.83	Moderate	Retain
4	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	1.02	Low	Retain
5	1	Platanus x acerifolia	London Plane	0.56	0.78	6.00	2.98	Moderate	Retain
6	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
7	1	Lophostemon confertus	Brush Box	0.60	0.60	7.20	3.09	Moderate	Retain
8	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.53	0.53	6.36	2.47	Moderate	Retain
9	1	Eucalyptus camaldulensis	River Red Gum	0.59	0.69	6.00	2.83	Low	Retain
10	1	Melaleuca styphelioides	Prickly Paperbark	0.40	0.38	4.80	2.13	Moderate	Retain
11	1	Casuarina cunninghamiana	River She-Oak	0.54	0.67	6.48	2.80	Moderate	Retain
12	1	Casuarina cunninghamiana	River She-Oak	0.45	0.55	5.40	2.73	Moderate	Retain
13	1	Casuarina cunninghamiana	River She-Oak	0.27	0.36	3.24	2.20	Low	Retain
14	1	Casuarina cunninghamiana	River She-Oak	0.45	0.55	5.40	2.76	Low	Retain
15	1	Casuarina cunninghamiana	River She-Oak	0.46	0.55	5.40	2.76	Moderate	Retain
16	1	Schinus areia	Peppercorn Tree	0.45	0.45	5.40	2.37	Moderate	Retain
17	1	Casuarina cunninghamiana	River She-Oak	0.40	0.50	4.80	2.67	Moderate	Retain
18	1	Casuarina cunninghamiana	River She-Oak	0.50	0.75	6.00	2.85	Moderate	Retain
19	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
20	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
21	1	Eucalyptus saligna	Sydney Blue Gum	0.55	0.70	6.60	2.85	Moderate	Retain
22	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
23	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Remove
24	1	Koelreuteria paniculata	Golden Rain Tree	0.05	0.05	2.00	0.94	Low	Retain
25	1	Lophostemon confertus	Brush Box	0.45	0.70	5.40	2.85	Moderate	Retain
26	1	Eucalyptus grandis	Flooded Gum	0.40	0.60	4.80	2.67	Moderate	Retain
27	1	Lophostemon confertus	Brush Box	0.30	0.45	3.60	2.37	Moderate	Retain
28	1	Eucalyptus botryoides	Bangalay	0.45	0.60	5.40	2.76	Moderate	Retain
29	1	Eucalyptus botryoides	Bangalay	0.25	0.40	3.00	2.25	Moderate	Retain
30	1	Eucalyptus robusta	Swamp Mahogany	0.30	0.40	3.60	2.25	Moderate	Retain
31	1	Eucalyptus nicholii	Narrow-leaved Black Peppermint	0.35	0.40	4.20	2.25	Low	Retain
32	1	Eucalyptus botryoides	Bluggs Ironbark	0.59	0.78	7.08	2.92	Moderate	Retain
33	1	Platanus x acerifolia	London Plane	0.35	0.60	4.20	2.47	Moderate	Retain
34	1	Eucalyptus botryoides	Bluggs Ironbark	0.47	0.67	5.64	2.80	Low	Retain
35	1	Eucalyptus punctata	Grey Gum	0.44	0.65	5.28	2.47	Moderate	Retain
36	1	Lophostemon confertus	Brush Box	0.44	0.58	5.28	2.63	Moderate	Retain
37	1	Schinus areia	Peppercorn Tree	0.46	0.64	5.76	2.55	Low	Retain
38	1	Eucalyptus deanei	Sugar Gum	0.57	0.85	6.84	2.81	Moderate	Retain
39	1	Eucalyptus nicholii	Narrow-leaved Black Peppermint	0.25	0.33	3.00	2.08	Low	Retain
40	1	Eucalyptus deanei	Sugar Gum	0.70	0.90	8.40	3.17	Moderate	Retain
41	1	Lophostemon confertus	Brush Box	0.55	0.60	6.60	2.73	Moderate	Retain
42	1	Grevillea robusta	Silky Oak	0.10	0.12	2.00	1.56	V Low / Remove	Remove
43	1	Agonis flexuosa	Willow Myrtle	0.18	0.25	2.00	1.85	V Low / Remove	Remove
44	1	Platanus x acerifolia	London Plane	0.54	0.70	6.48	2.85	Moderate	Retain
45	1	Ficus benjamina	Weeping Fig	0.21	0.35	2.52	1.94	Low	Retain
46	1	Melia azedarach	White Cedar	0.20	0.27	2.40	1.91	Low	Retain
47	1	Melia azedarach	White Cedar	0.19	0.25	2.28	1.88	Low	Retain
48	1	Koelreuteria bipinnata	Chinese Rain Tree	0.03	0.05	2.00	0.94	Low	Retain
49	1	Platanus x acerifolia	London Plane	0.62	0.75	7.44	2.88	High	Retain
50	1	Platanus x acerifolia	London Plane	0.50	0.59	6.00	2.65	Moderate	Retain
51	1	Corymbia citriodora	Lemon Scented Gum	0.51	0.62	6.12	2.71	Moderate	Retain
201	1	Eucalyptus microcorys	Tallowood	0.74	0.91	8.88	3.18	Moderate	Retain
202	1	Platanus x acerifolia	London Plane	0.82	0.96	9.84	3.25	Moderate	Retain
203	1	Platanus x acerifolia	London Plane	0.63	0.78	7.56	2.98	Moderate	Retain
204	1	Eucalyptus microcorys	Tallowood	0.56	0.69	6.72	2.83	High	Retain
205	1	Phoenix canariensis	Canary Island Date Palm	0.74	0.91	8.88	3.27	Low	Retain
206	1	Phoenix canariensis	Canary Island Date Palm	0.75	0.91	9.00	3.27	Moderate	Retain
207	1	Cinnamomum camphora	Camphor Laurel	0.87	0.96	8.04	1.08	Moderate	Retain
208	1	Cinnamomum camphora	Camphor Laurel	1.52	1.75	15.00	4.19	High	Retain
209	1	Phoenix canariensis	Canary Island Date Palm	0.64	0.85	7.68	3.09	High	Retain
210	1	Eucalyptus scoparia	Wallangarra White Gum	0.38	0.47	4.68	2.41	Low	Remove
211	1	Celtis sinensis	Chinese Hackberry	0.29	0.35	3.48	2.47	V Low / Remove	Remove
212	1	Celtis sinensis	Chinese Hackberry	0.14	0.22	2.00	1.75	V Low / Remove	Remove
213	1	Melaleuca bracteata	Black Tea-Tree	0.15	0.24	2.00	1.82	Low	Remove
214	1	Melaleuca bracteata	Black Tea-Tree	0.17	0.23	2.04	1.88	Low	Remove
215	1	Melaleuca bracteata	Black Tea-Tree	0.20	0.32	2.40	2.05	Low	Remove
216	1	Melaleuca bracteata	Black Tea-Tree	0.21	0.30	2.52	2.13	Low	Remove
217	1	Melaleuca bracteata	Black Tea-Tree	0.23	0.30	2.76	2.15	Low	Remove
218	1	Ligustrum lucidum	Broadleaf Privet	0.49	0.49	5.88	2.45	V Low / Remove	Remove
219	1	Grevillea robusta	Silky Oak	0.28	0.37	3.12	2.18	V Low / Remove	Remove
220	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.20	0.22	2.40	1.68	Low	Remove
221	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.12	0.15	2.00	1.36	Low	Remove
222	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.28	0.28	3.36	1.94	Low	Remove
223	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.19	0.19	2.28	1.65	Low	Remove
224	1	Celtis sinensis	Chinese Hackberry	0.13	0.15	2.00	1.49	V Low / Remove	Remove
225	1	Acacia parramattensis	Parramatta Wattle	0.37	0.37	4.44	2.61	Low	Remove
226	1	Eucalyptus pilularis ?	Blackbutt	0.36	0.46	4.32	2.43	V Low / Remove	Remove
227	1	Acacia parramattensis	Parramatta Wattle	0.32	0.40	3.84	2.25	Low	Remove
228	1	Celtis sinensis	Chinese Hackberry	0.50	0.58	6.00	2.57	V Low / Remove	Remove
229	1	Celtis sinensis	Chinese Hackberry	0.20	0.30	2.40	2.13	V Low / Remove	Remove
230	1	Celtis sinensis	Chinese Hackberry	0.31	0.33	3.72	2.05	V Low / Remove	Remove
231	1	Celtis sinensis	Chinese Hackberry	0.14	0.22	2.00	1.75	V Low / Remove	Remove
232	1	Celtis sinensis	Chinese Hackberry	0.34	0.34	4.08	2.10	V Low / Remove	Remove
233	1	Celtis sinensis	Chinese Hackberry	0.40	0.40	4.80	2.25	V Low / Remove	Remove
234	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.25	0.30	3.00	1.88	Low	Remove
235	2	Celtis sinensis	Chinese Hackberry	0.16	0.22	2.00	1.75	V Low / Remove	Remove
236	1	Eucalyptus punctata	Grey Gum	0.21	0.30	2.52	2.00	Low	Remove
237	1	Eucalyptus punctata	Grey Gum	0.29	0.33	3.48	2.08	Low	Remove
238	1	Celtis sinensis	Chinese Hackberry	0.22	0.31	2.64	2.02	V Low / Remove	Remove
239	1	Celtis sinensis	Chinese Hackberry	0.16	0.19	2.00	1.61	V Low / Remove	Remove
240	1	Eucalyptus punctata	Grey Gum	0.06	0.11	2.00	1.31	Low	Remove
241	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.42	0.50	5.04	3.00	Low	Remove
242	3	Celtis sinensis	Chinese Hackberry	0.16	0.19	2.00	1.65	V Low / Remove	Remove
243	1	Celtis sinensis	Chinese Hackberry	0.26	0.30	3.12	2.23	V Low / Remove	Remove
244	1	Celtis sinensis	Chinese Hackberry	0.15	0.17	2.00	1.36	V Low / Remove	Remove
245	1	Malus sp.	Apple or Crabapple	0.28	0.34	3.36	2.10	Moderate	Remove
246	1	Ficus rubiginosa	Port Jackson Fig	0.28	0.31	3.36	2.08	Moderate	Remove
247	1	Sapium sebiferum	Chinese Tallow Tree	0.12	0.22	2.00	1.91	Low	Remove
248	1	Celtis sinensis	Chinese Hackberry	0.32	0.40	3.84	1.39	V Low / Remove	Remove
249	1	Celtis sinensis	Chinese Hackberry	0.50	0.64	6.00	2.74	Moderate	Remove
250	1	Cupressus macrocarpa	Monterey Cypress	0.27	0.27	3.24	1.91	Low	Remove
251	1	Eriobotrya japonica	Loquat	0.29	0.30	3.48	2.08	Low	Remove
252	1	Celtis sinensis	Chinese Hackberry	0.52	0.75	6.24	2.93	V Low / Remove	Remove
253	1	Celtis sinensis	Chinese Hackberry	0.40	0.60	4.80	2.67	V Low / Remove	Remove
254	1	Waterhousea heterophylla	Illawarra Island Pine	0.15	0.19	2.00	1.61	Low	Remove
255	1	Celtis sinensis	Chinese Hackberry	0.40	0.60	4.80	2.67	V Low / Remove	Remove
256	2	Celtis sinensis	Chinese Hackberry	0.18	0.20	2.16	1.68	V Low / Remove	Remove
257	1	Callistemon viminalis cv.	Weeping Bottlebrush	0.12	0.16	2.00	1.61	Low	Remove
258	1	Celtis sinensis	Chinese Hackberry	0.09	0.12	2.00	1.26	V Low / Remove	Remove
259	1	Celtis sinensis	Chinese Hackberry	0.07	0.09	2.00	1.20	V Low / Remove	Remove
260	2	Celtis sinensis	Chinese Hackberry	0.60	0.80	7.20	2.76	V Low / Remove	Remove
261	1	Celtis sinensis	Chinese Hackberry	0.70	0.80	8.40	3.01	V Low / Remove	Remove
262	2	Celtis sinensis	Chinese Hackberry	0.27	0.30	3.24	2.00	V Low / Remove	Remove
263	1	Ficus rubiginosa	Port Jackson Fig	1.20	1.50	14.40	3.92	Moderate	Retain
264	1	Eriobotrya japonica	Loquat	0.20	0.30	2.40	2.00	Low	Remove
265	1	Celtis sinensis	Chinese Hackberry	0.16	0.19	2.00	1.40	V Low / Remove	Remove
266	1	Celtis sinensis	Chinese Hackberry	0.20	0.30	2.40	2.00	V Low / Remove	Remove
267	1	Jacaranda mimosifolia	Jacaranda	0.50	0.70	6.00	2.85	Moderate	Retain
268	1	Celtis sinensis	Chinese Hackberry	0.36	0.50	4.32	2.47	V Low / Remove	Remove
269	1	Celtis sinensis	Chinese Hackberry	0.18	0.30	2.16	2.00	V Low / Remove	Remove
270	1	Casuarina cunninghamiana	River She-Oak	0.60	0.70	7.20	2.85	Low	Remove
271	1	Ficus rubiginosa	Port Jackson Fig	0.60	0.70	7.20	2.85	Moderate	Retain
272	1	Cupressus macrocarpa	Monterey Cypress	0.30	0.40	3.60	2.67	Moderate	Remove
273	22	Celtis sinensis	Chinese Hackberry	0.20	0.25	2.40	1.85	V Low / Remove	Remove
274	6	Celtis sinensis	Chinese Hackberry	0.50	0.65	6.00	2.57	V Low / Remove	Remove
275	1	Platanus x acerifolia	London Plane	0.35	0.40	4.20	2.25	Low	Remove
276	3	Melaleuca bracteata	Black Tea-Tree	0.35	0.40	4.20	2.25	Low	Remove
277	1	Eucalyptus saligna	Sydney Blue Gum	0.15	0.18	2.00	1.61	Moderate	Remove
278	1	Eucalyptus saligna	Sydney Blue Gum	0.09	0.12	2.00	1.26	V Low / Remove	Remove
279	1	Eucalyptus saligna	Sydney Blue Gum	0.07	0.10	2.00	1.26	Low	Remove
280	1	Syagrus romanzoffiana	Queen Palm	0.20	0.20	2.40	1.68	V Low / Remove	Remove
281	1	Eucalyptus saligna	Sydney Blue Gum	0.18	0.28	2.16	1.94	Low	Remove
282	1	Eucalyptus saligna	Sydney Blue Gum	0.15	0.19	2.00	1.53	Low	Remove
283	1	Eucalyptus saligna	Sydney Blue Gum	0.11	0.16	2.00	1.49	Low	Remove
284	1	Sapium sebiferum	Chinese Tallow Tree	0.12	0.15	2.00	1.49	Low	Remove
287	1	Celtis sinensis	Chinese Hackberry	0.20	0.22	2.00	1.68	V Low / Remove	Remove
288	1	Celtis sinensis	Chinese Hackberry	0.36	0.45	4.20	2.30	V Low / Remove	Remove
289	1	Xylomelum pyriforme	Native Pomegranate	0.15	0.20	2.00	1.68	Low	Retain
290	1	Xylomelum pyriforme	Native Pomegranate	0.16	0.19	2.00	1.65	Moderate	Retain

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SUITE 602 / 51 RAWSON STREET, EPPING, NSW 2121
P 02 9957 2466 **F** 02 9957 3977 **W** ARTERRA.COM.AU

REVISION	DESCRIPTION	DRD	DATE
B	For Information-Revised MP	RWS	25.03.22
A	For Information	RWS	01.11.21

PROJECT & CLIENT

Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE

Tree Protection & Removal Key Plan

Project No : 19.03
Designed : RWS
Drawn : RWS/CLB
Scale : 1:2500@A1 / 1:5000@A3

DRAWING NUMBER T-00

REVISION B

Plotted at : 9:41 am 25/3/2022

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Tree Protection & Removal Legend

- Precinct Boundary
- Cadastre
- T26 Tree Identification Number
- Existing Tree to be Retained & Protected
- Existing Tree to be Removed
- Nominal Tree Protection Zone Radius (TPZ)
  (shown for High & Moderate retention value trees only)

0 5 10 25m

REVISION	DESCRIPTION	CHKD	DATE
B	For Information Revised MP	RWS	25.02
A	For Information	RWS	01.10.21

PROJECT & CLIENT

Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE

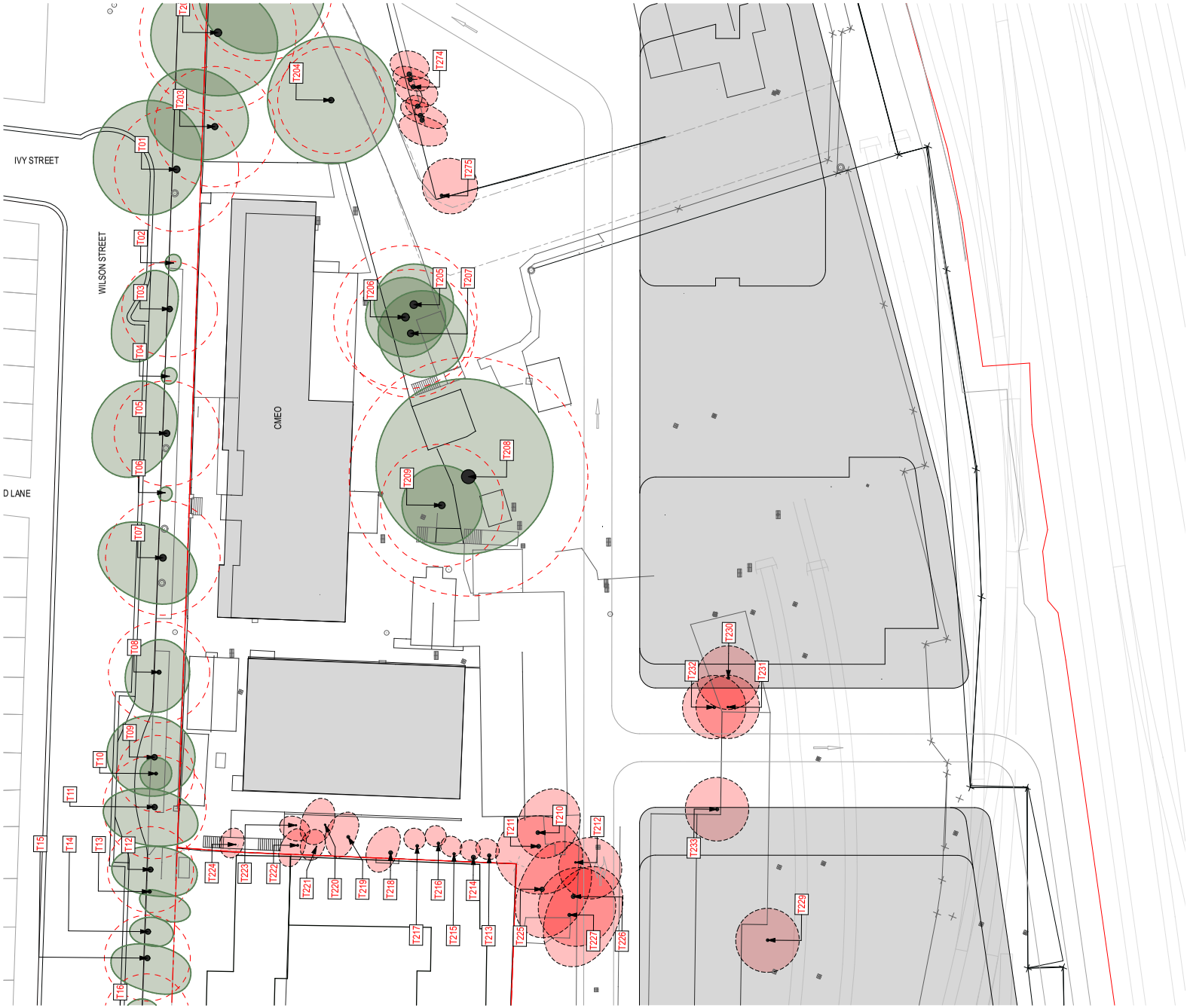
Tree Protection & Removal Map 01

Project No	:	19.03
Designed	:	RWS
Drawn	:	RWS/CLB
Scale	:	1:250@A1 / 1:500@A3

DRAWING NUMBER T-01

REVISION B

Plotted at : 9:41 am 25/3/2022



Tree Protection & Removal Legend

- Precinct Boundary
- Cadastre
- T26 Tree Identification Number
- Existing Tree to be Retained & Protected
- Existing Tree to be Removed
- Nominal Tree Protection Zone Radius (TPZ)
  (shown for High & Moderate retention value trees only)

0 5 10 25m

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REVISION	DESCRIPTION	CHKD	DATE
B	For Information Revised MP	RWS	25.02.22
A	For Information	RWS	01.10.21

PROJECT & CLIENT

Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE

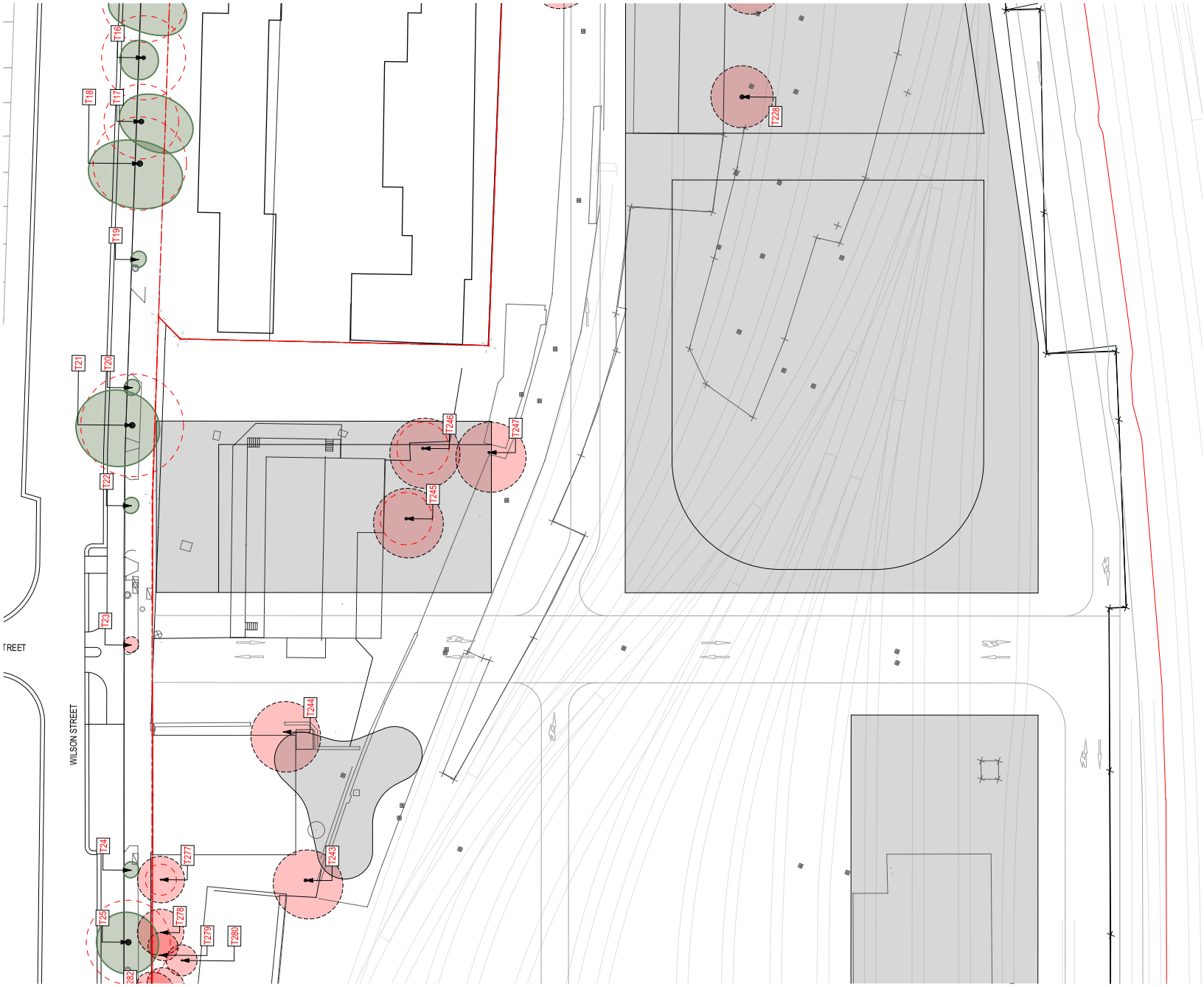
Tree Protection & Removal Map 02

Project No	:	19.03
Designed	:	RWS
Drawn	:	RWS/CLB
Scale	:	1:250@A1 / 1:500@A3

DRAWING NUMBER T-02

REVISION B

Plotted at : 9:41 am 25/3/2022



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Tree Protection & Removal Legend

- Precinct Boundary
- Cadastre
- T26 Tree Identification Number
- Existing Tree to be Retained & Protected
- Existing Tree to be Removed
- Nominal Tree Protection Zone Radius (TPZ)
  (shown for High & Moderate retention value trees only)

0 5 10 25m

REVISION	DESCRIPTION	CHKD	DATE
B	For Information Revised MP	RWS	25.02
A	For Information	RWS	01.10.21

PROJECT & CLIENT

Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE

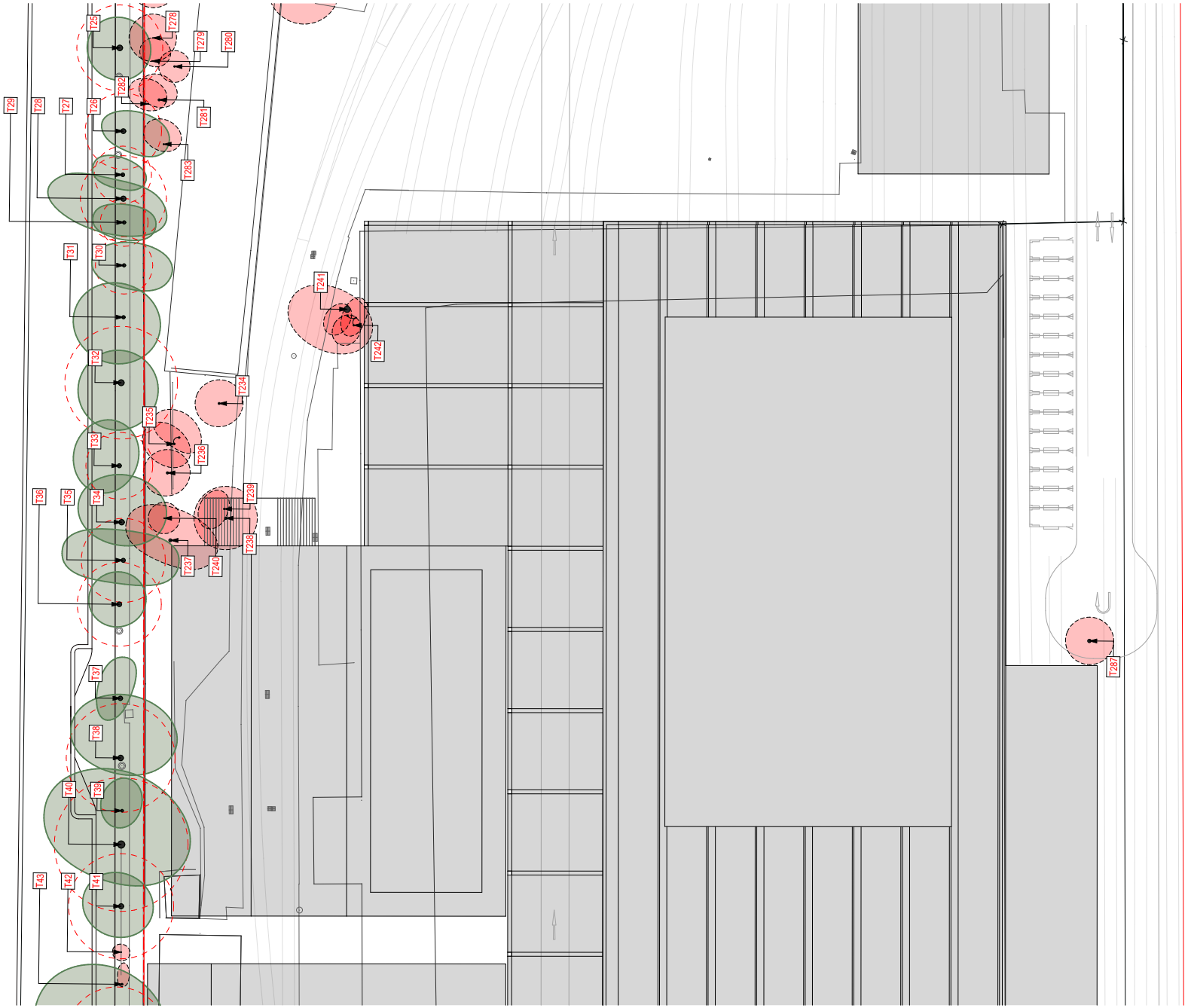
Tree Protection & Removal Map 03

Project No	:	19.03
Designed	:	RWS
Drawn	:	RWS/CLB
Scale	:	1:250@A1 / 1:500@A3

DRAWING NUMBER T-03

REVISION B

Plotted at : 9:41 am 25/3/2022



Tree Protection & Removal Legend

- Precinct Boundary
- Cadastre
- T26 Tree Identification Number
- Existing Tree to be Retained & Protected
- Existing Tree to be Removed
- Nominal Tree Protection Zone Radius (TPZ)
  (shown for High & Moderate retention value trees only)

0 5 10 25m

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REVISION	DESCRIPTION	CHKD	DATE
B	For Information Revised MP	RWS	25.02.22
A	For Information	RWS	01.10.21

PROJECT & CLIENT

Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE

Tree Protection & Removal Map 04

Project No	:	19.03
Designed	:	RWS
Drawn	:	RWS/CLB
Scale	:	1:250@A1 / 1:500@A3

DRAWING NUMBER: T-04

REVISION: B

Plotted at : 9:41 am 25/3/2022

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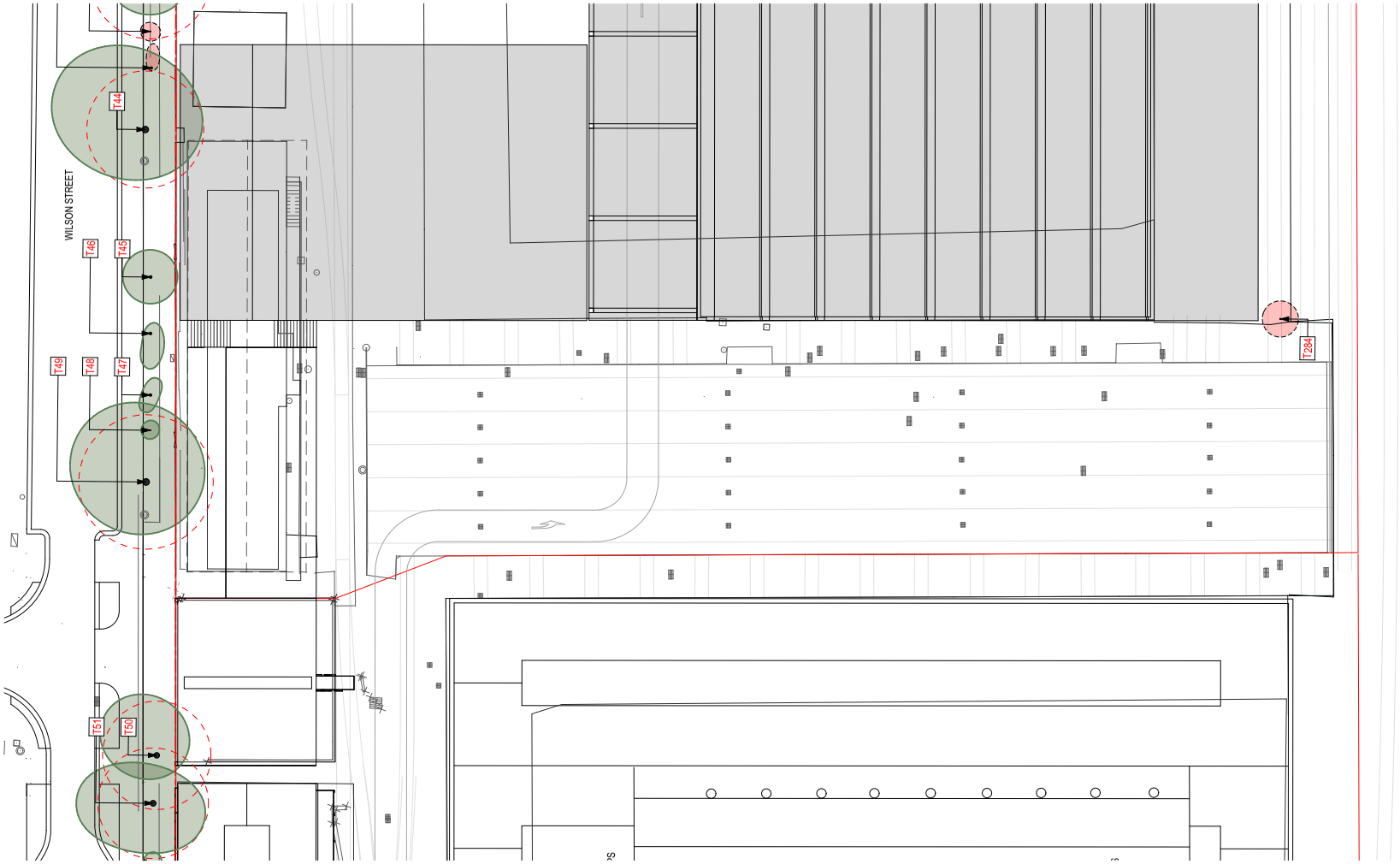
Tree Protection & Removal Legend

- Precinct Boundary
- Cadastre
- T26 Tree Identification Number
- Existing Tree to be Retained & Protected
- Existing Tree to be Removed
- Nominal Tree Protection Zone Radius (TPZ)
  (shown for High & Moderate retention value trees only)



0 5 10 25m

REVISION	DESCRIPTION	CHKD	DATE
B	For Information Revised MP	RWS	25.02.22
A	For Information	RWS	01.10.21

PROJECT & CLIENT
Redfern North Eveleigh - UFS

UrbanGrowth NSW

DRAWING TITLE
Tree Protection & Removal Map 05

Project No	:	19.03
Designed	:	RWS
Drawn	:	RWS/CLB
Scale	:	1:250@A1 / 1:500@A3

DRAWING NUMBER T-05
REVISION B

Plotted at : 9:41 am 25/3/2022

6.4 Typical Planting Details

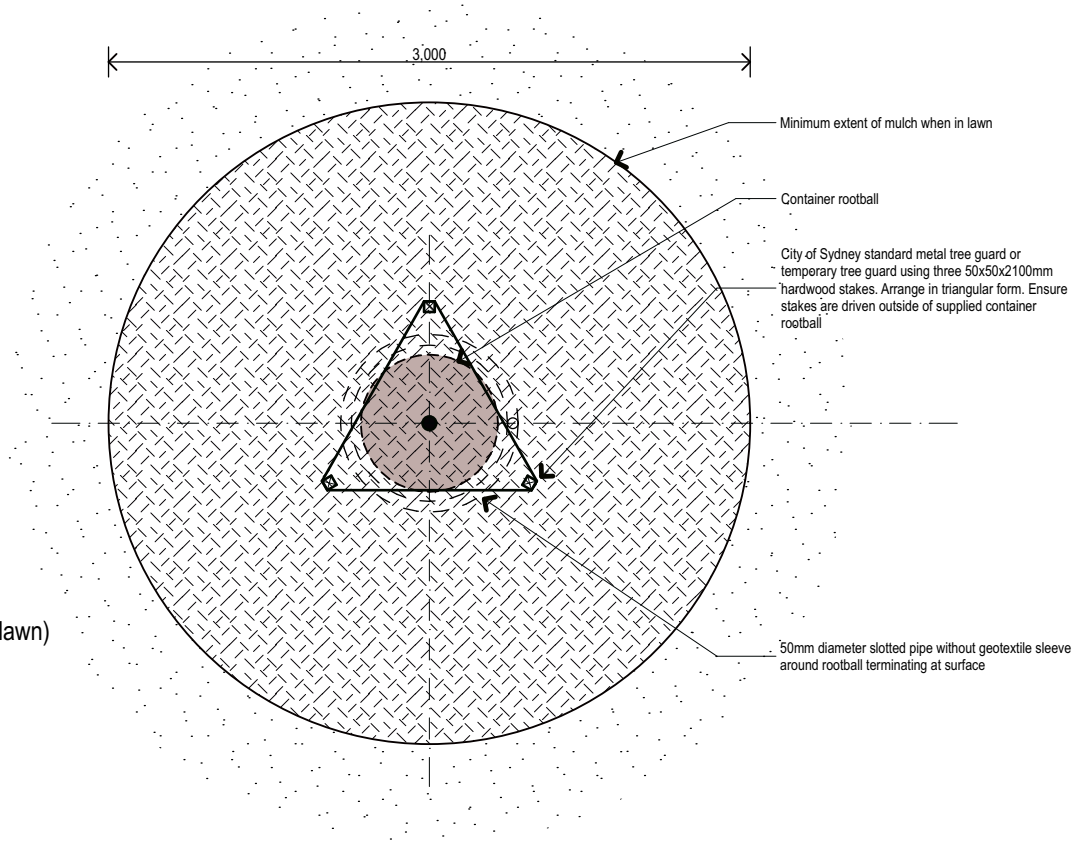
The following pages are the currently unpublished but standard tree planting details for the CoS. They have been reproduced here with the permission of the CoS to assist and facilitate appropriate installation of public trees. These supersede the current planting details that are contained within the current CoS Street Tree Master Plan 2015.

These details are generic and standard details. They should be referred to as a guide only to appropriate tree planting and proper resolution of elements related to street and public area tree planting. Detailed and site specific details will be expected to be produced during refinement and detailed design stages of the proposed new development. Future appointed designers and developers are encouraged to refer to these details for guidance on the minimum standards and general approaches that will expected. Soil volumes and dimensions applied and specified specifically for the Paint Shop Sub-Precinct shall take priority over any inferred within these following details.

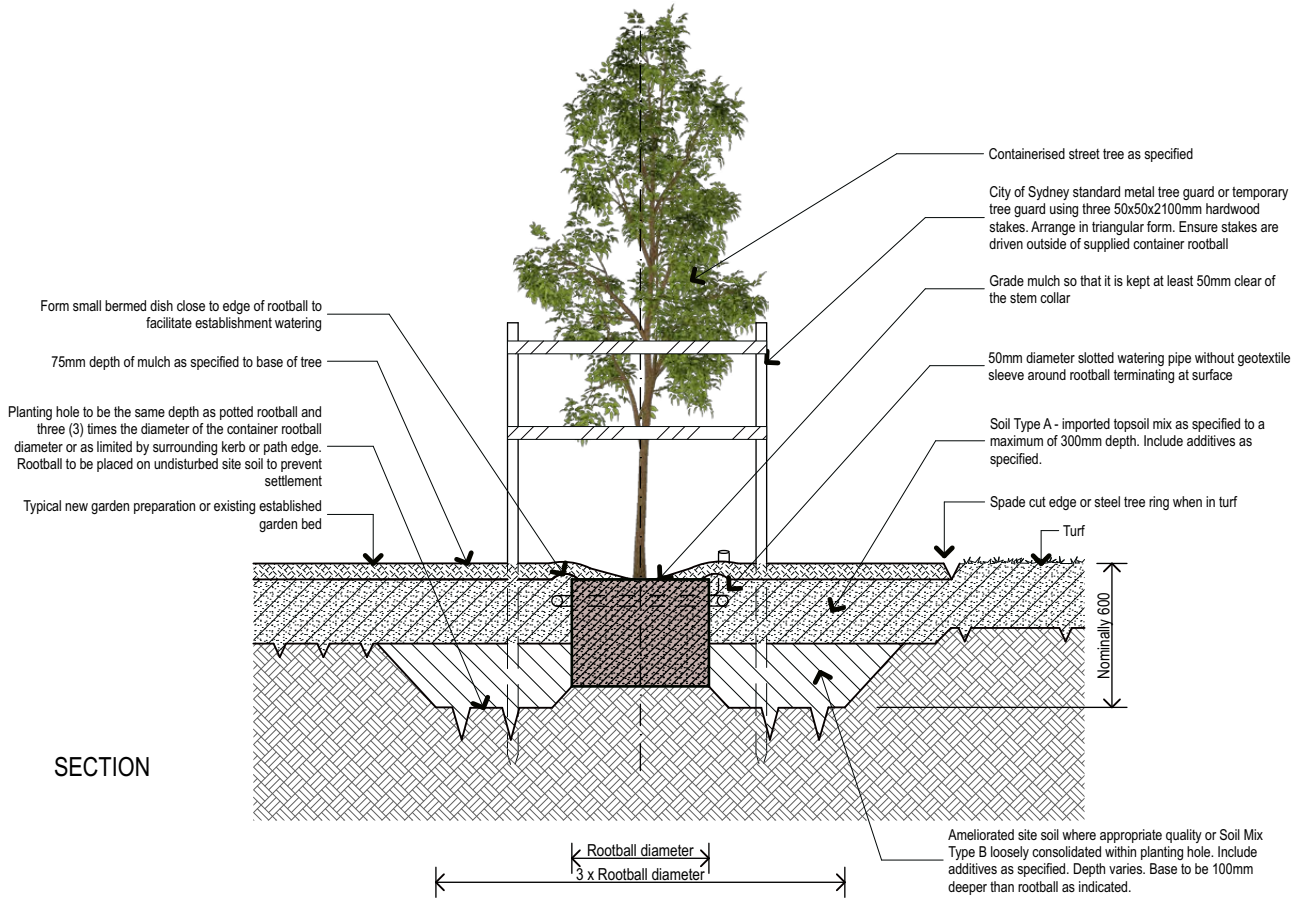
These details may be subsequently superseded by later revisions to policy, codes and plans that may be prepared by the CoS or specific details prepared and/ or conditioned as part of Redfern North Eveleigh Paint Shop Sub-Precinct approvals.

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

PLAN (When in lawn)



SECTION

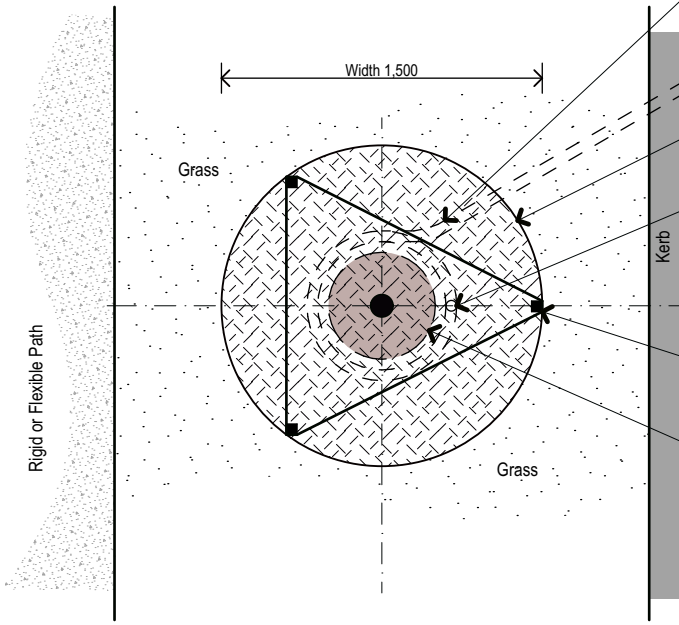


Scale 1: 25 @ A3 0 500 1000mm

TYPE 1 - TREE PLANTING IN WIDE OPEN TURF

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

PLAN



WSUD OPTION:
Cut 50mm diam. hole at 30-45º angle towards direction of flow into gutter and push slotted pipe into end for passive watering from stormwater flows

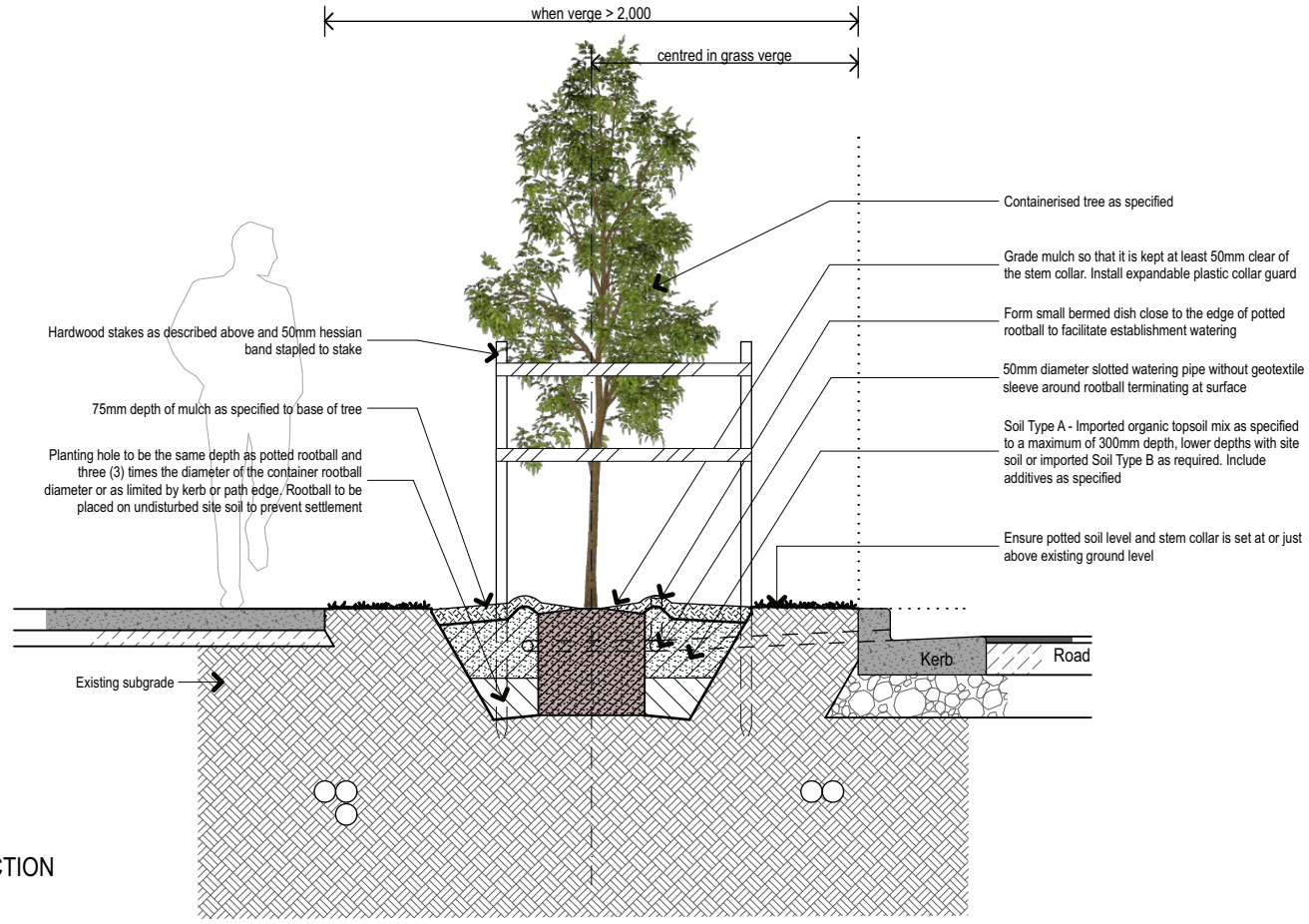
Planting hole to be three (3) times the diameter of the container rootball diameter or as limited by kerb or path edge. 75mm depth of mulch as specified (Chipped recycled wood waste, no fines, if nothing specified) to the base of tree to the extent of planting hole excavation. Tree planting area edging as specified by Council. (No edge if nothing specified)

50mm diameter slotted pipe without geotextile sleeve around rootball terminating at surface

Temporary tree guard using three 50x50x1800mm hardwood stakes at edge of planting pit. Arrange in triangular form to minimise conflict with opening car doors. Ensure stakes are driven outside of supplied container rootball

Container rootball

SECTION

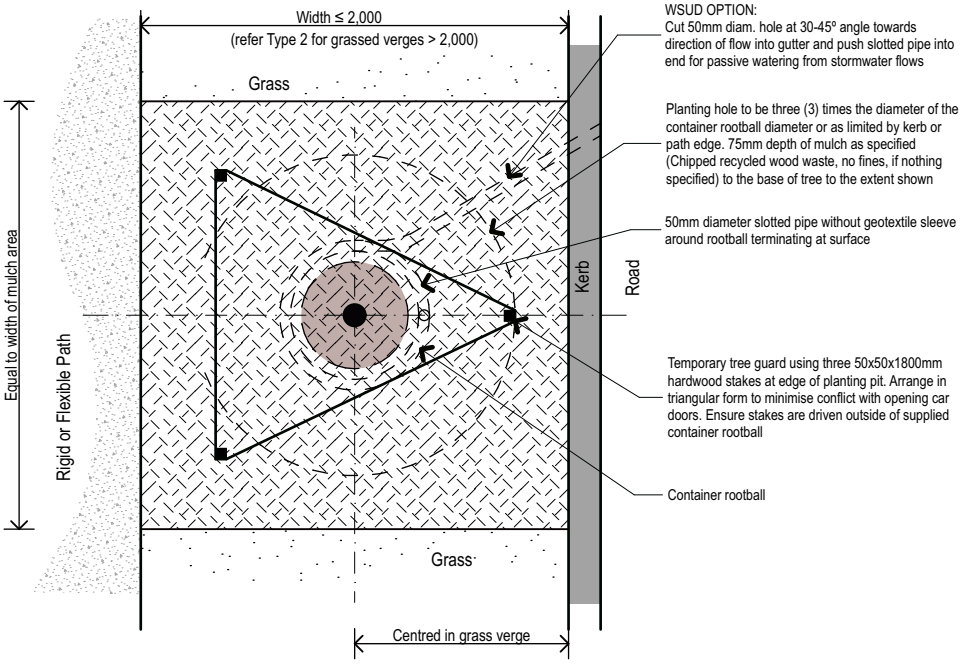


Scale 1: 25 @ A3 0 500 1000mm

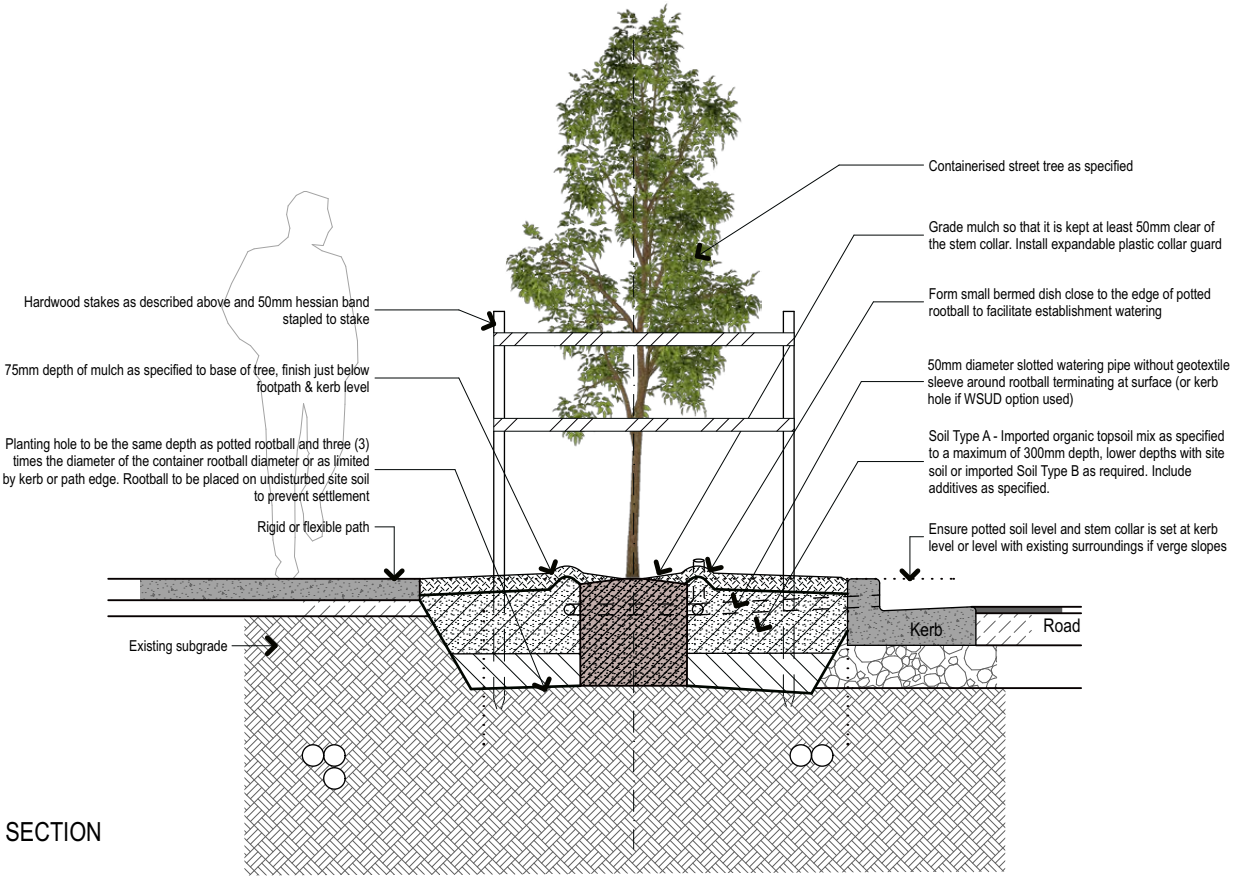
TYPE 2 - TREE PLANTING IN WIDE GRASSED VERGE

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

PLAN



SECTION

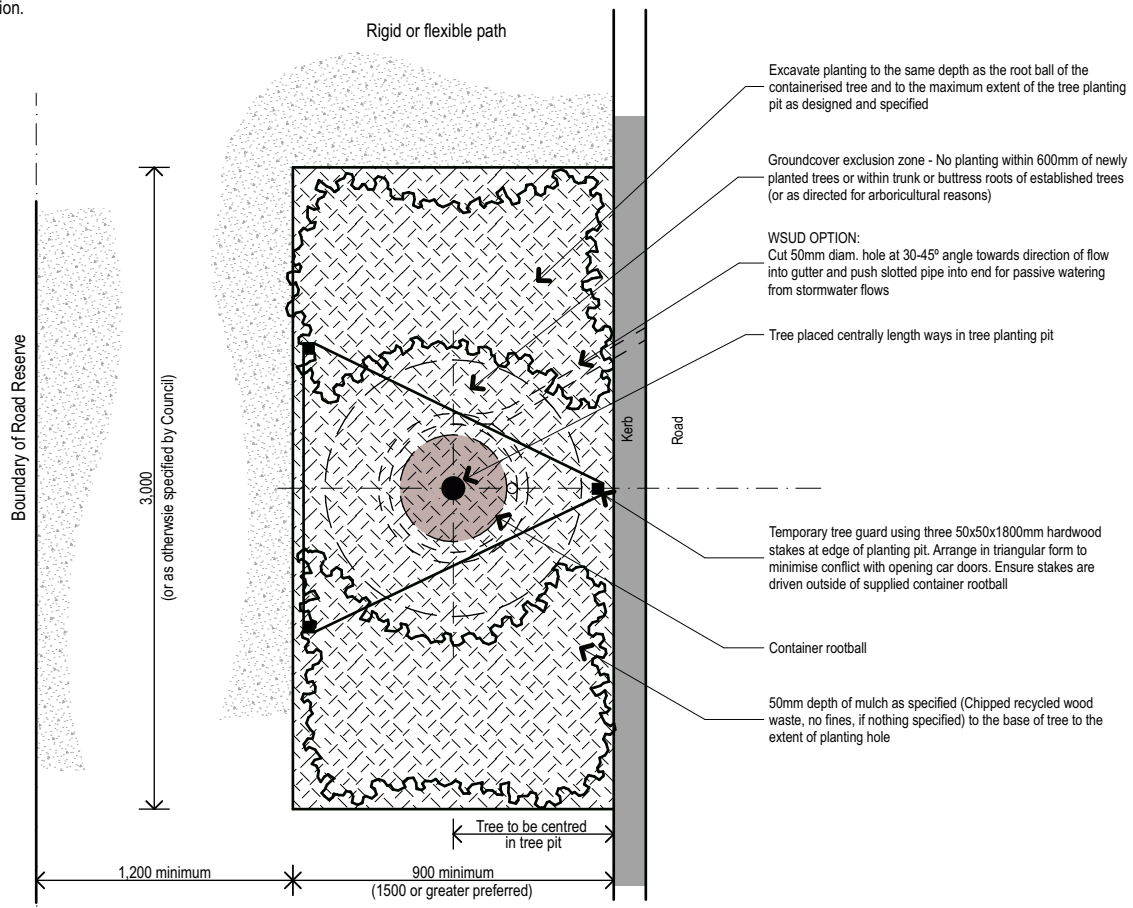


Scale 1: 25 @ A3 0 500 1000mm

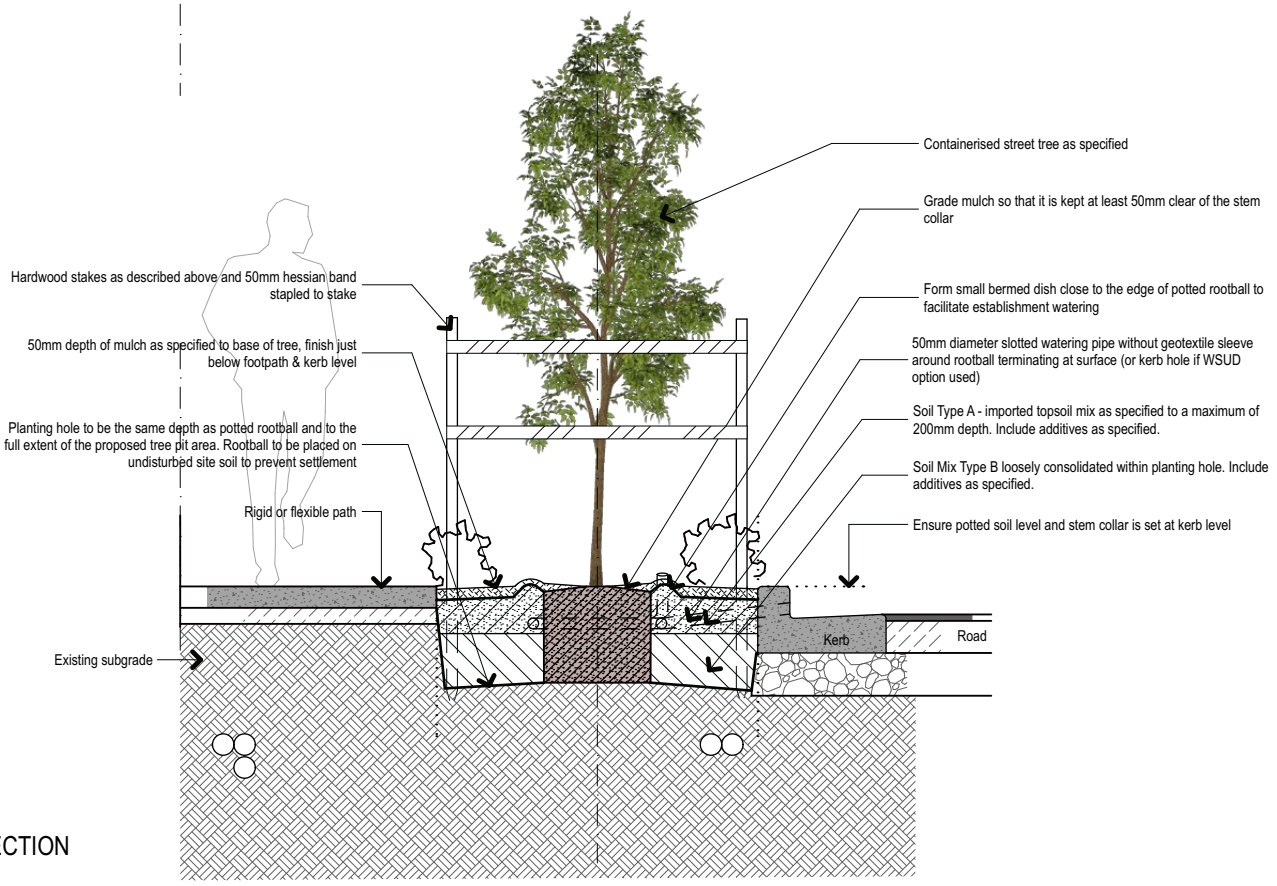
TYPE 3 - TREE PLANTING IN NARROW GRASSED VERGE

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

PLAN



SECTION

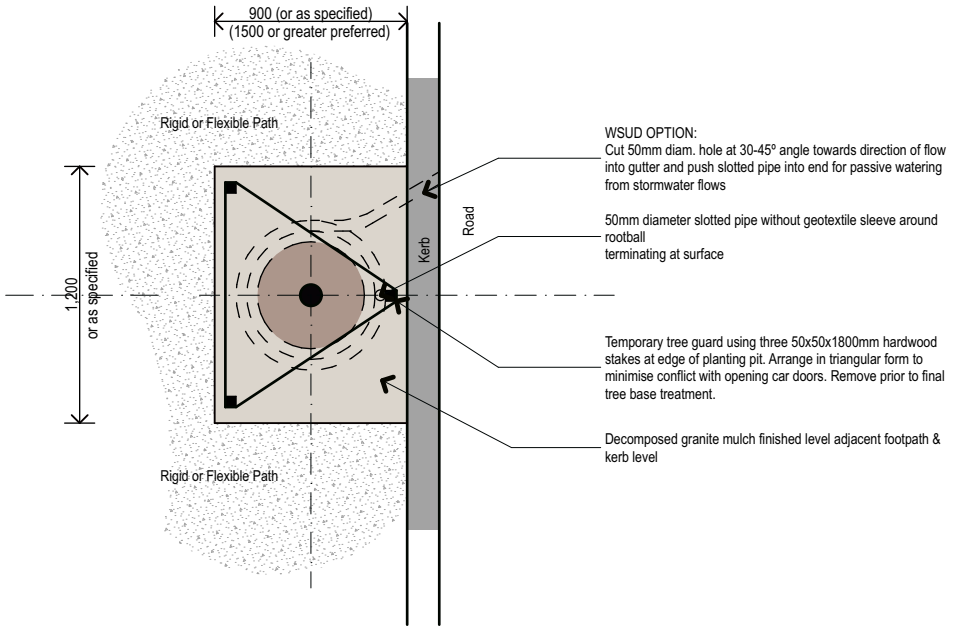


Scale 1: 25 @ A3 0 500 1000mm

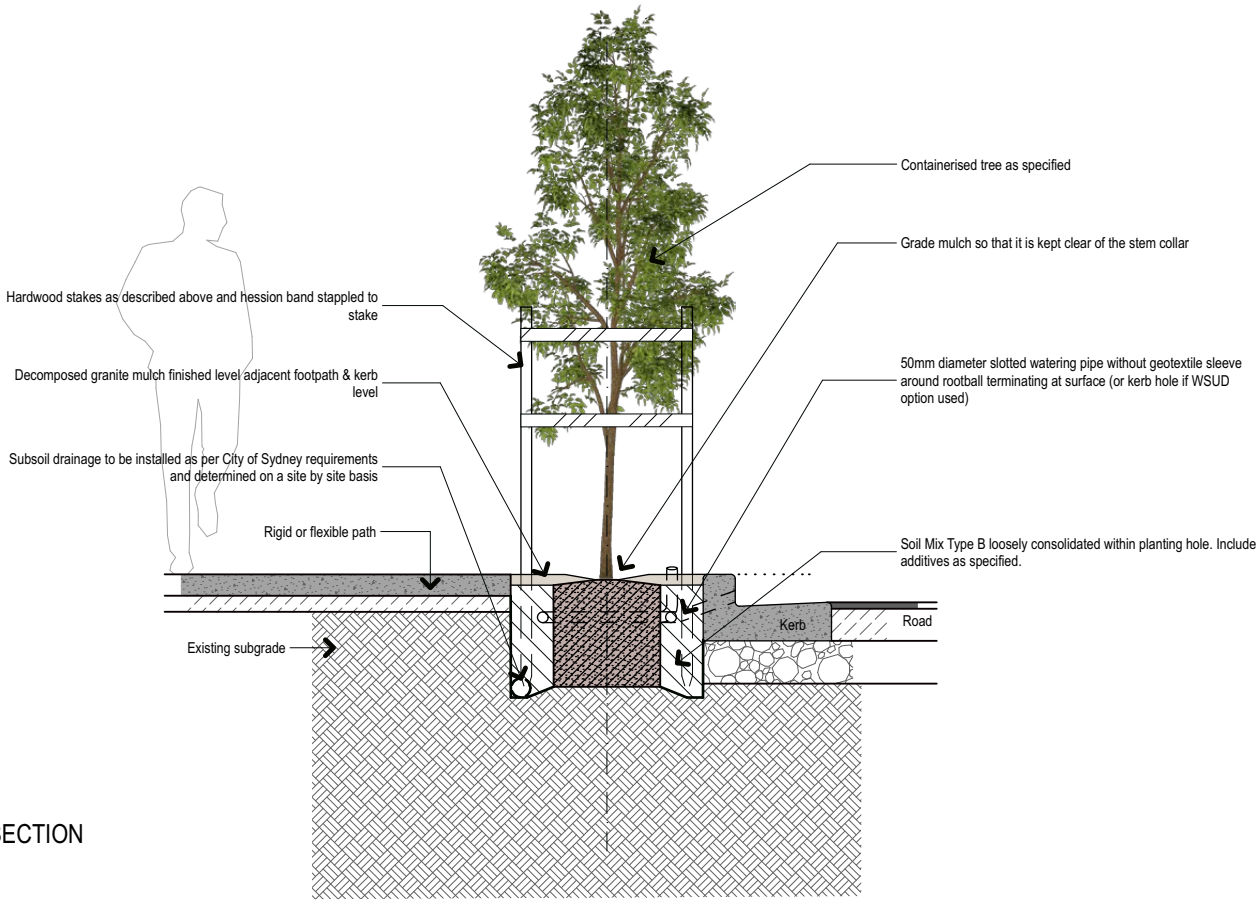
TYPE 4 - TREE PLANTING IN FULLY PAVED VERGE WITHIN STREET GARDEN

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

NOTE 2: Existing Trees
a. Size of tree pit may vary depending on depth of surface roots or trunk flare of mature trees.
b. Paving construction may be altered to accommodate tree roots at the direction of Council.
c. Tree pit surface to be installed level with surrounding paving, leaving surface roots exposed where necessary.



PLAN



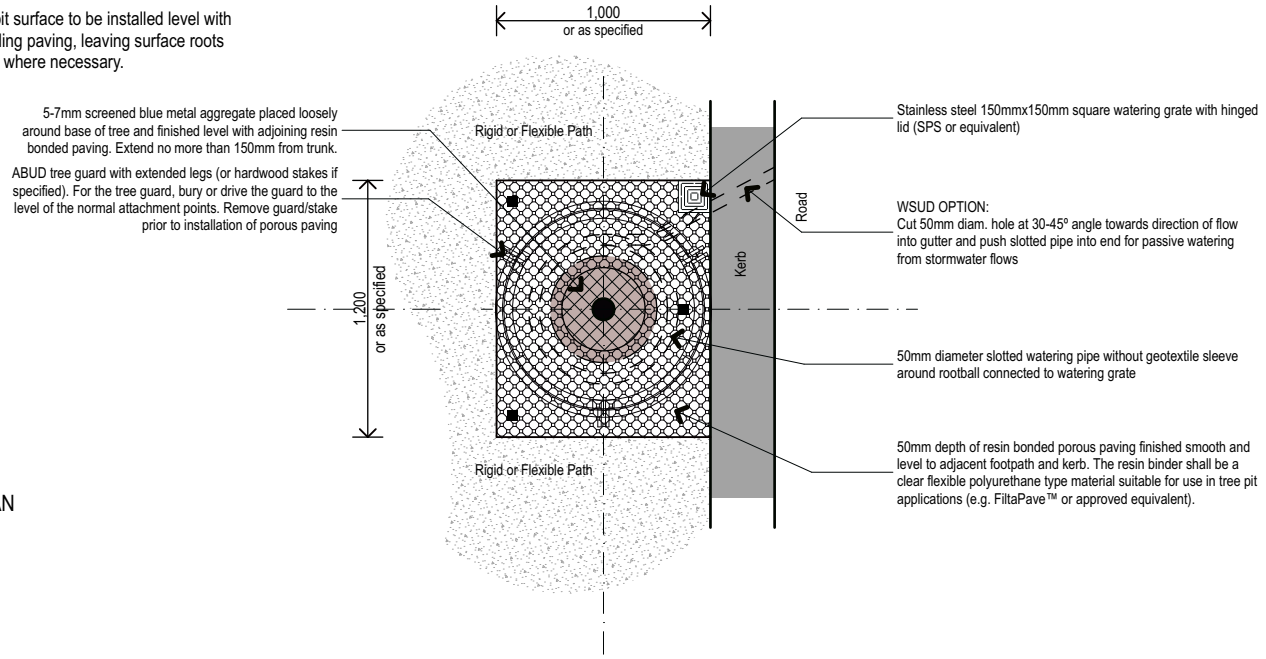
SECTION

Scale 1: 25 @ A3 0 500 1000mm

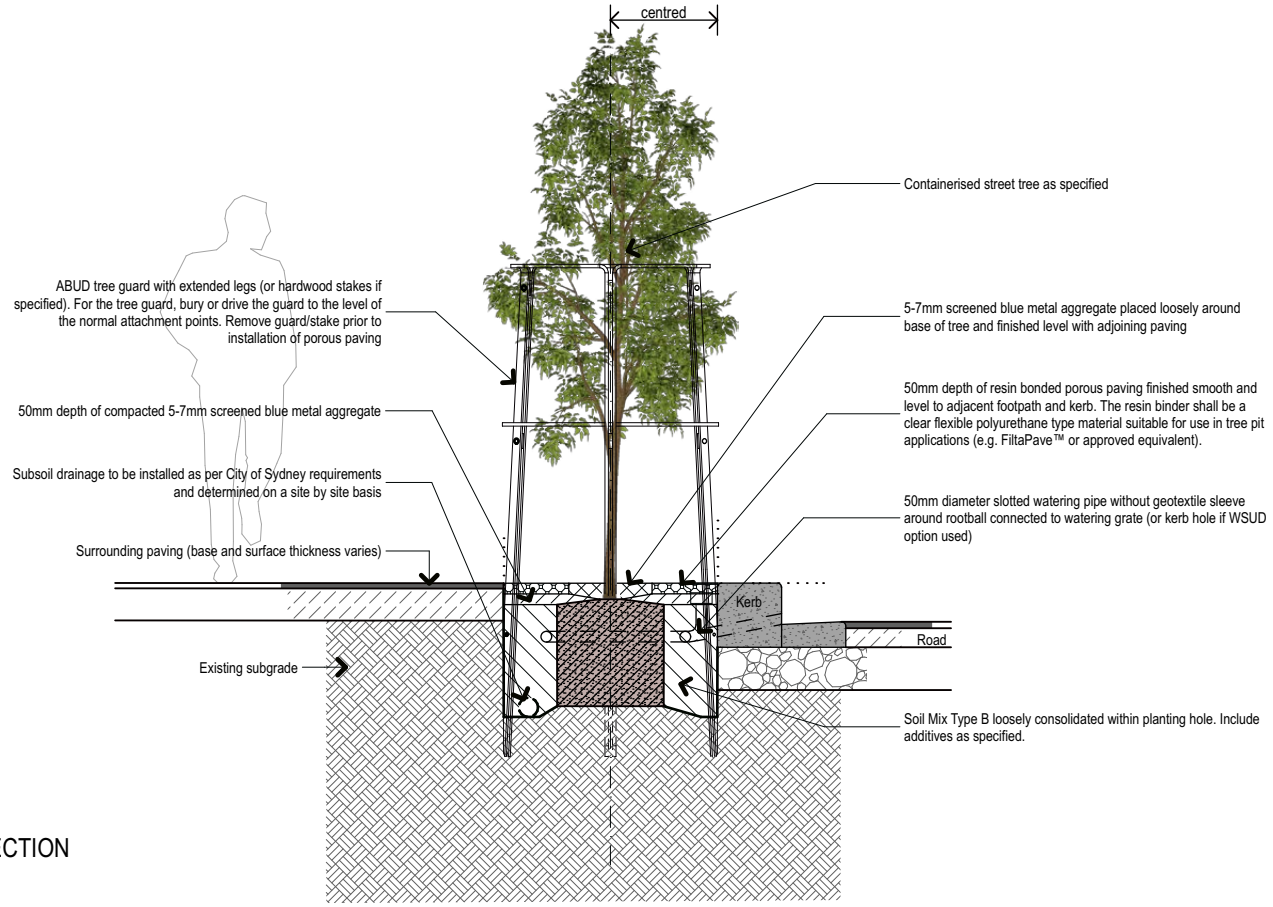
TYPE 5 - TREE PLANTING WITH DECOMPOSED GRANITE SURROUND

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

NOTE 2: Existing Trees
a. Size of tree pit may vary depending on depth of surface roots or trunk flare of mature trees.
b. Paving construction may be altered to accommodate tree roots at the direction of Council.
c. Tree pit surface to be installed level with surrounding paving, leaving surface roots exposed where necessary.



PLAN



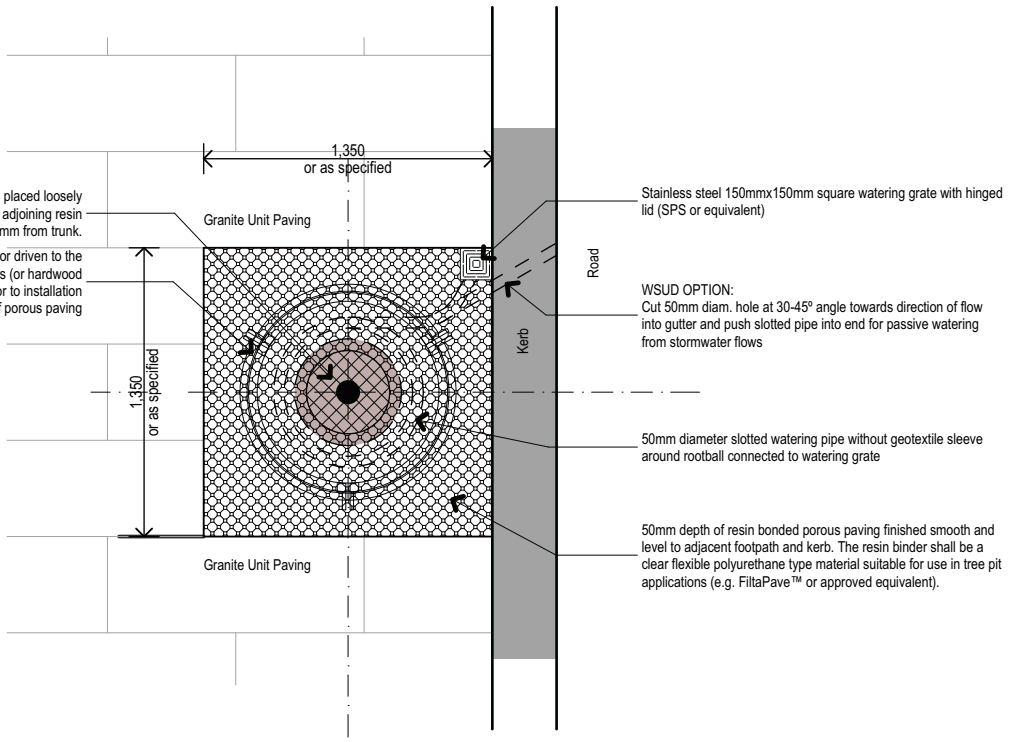
SECTION

Scale 1: 25 @ A3 0 500 1000mm

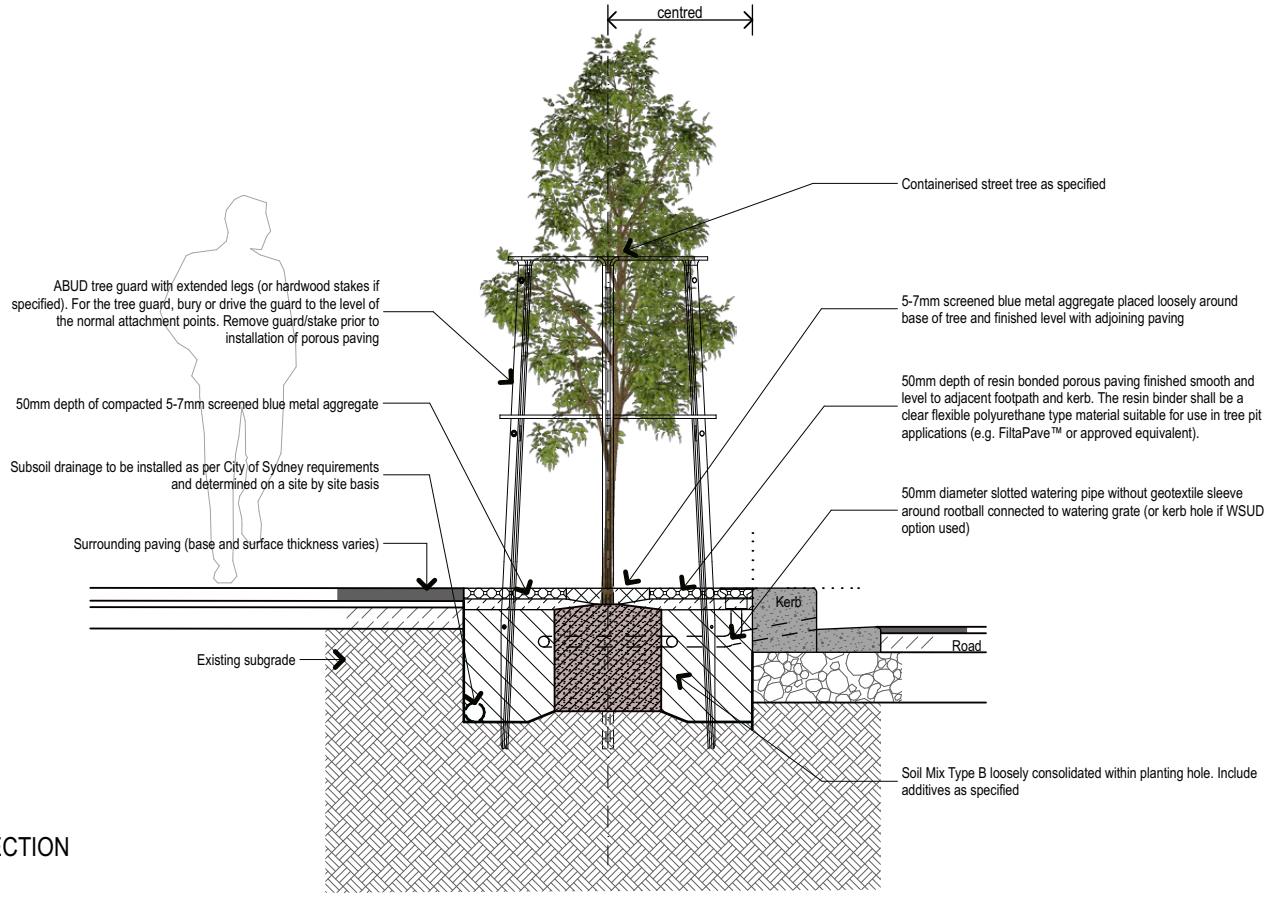
TYPE 6 - TREE PLANTING WITH POROUS PAVING SURROUND

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

NOTE 2: Existing Trees
a. Size of tree pit may vary depending on depth of surface roots or trunk flare of mature trees.
b. Paving construction may be altered to accommodate tree roots at the direction of Council.
c. Tree pit surface to be installed level with surrounding paving, leaving surface roots exposed where necessary.



PLAN

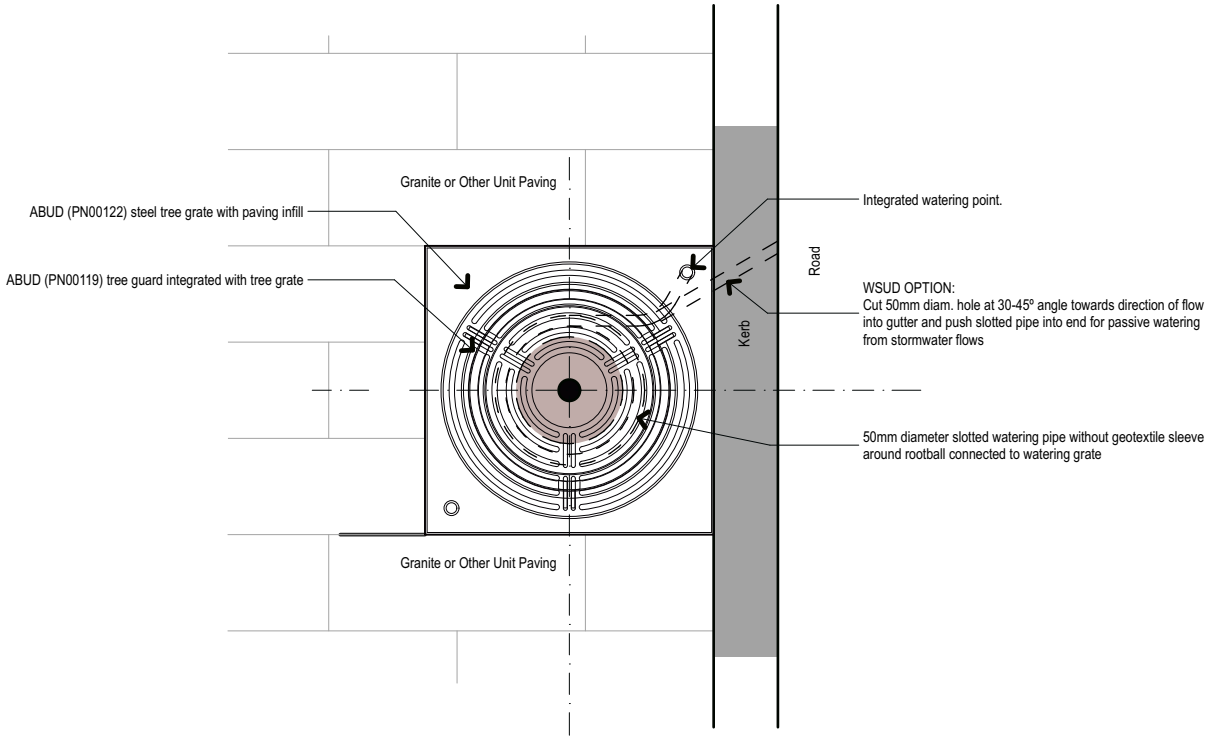


SECTION

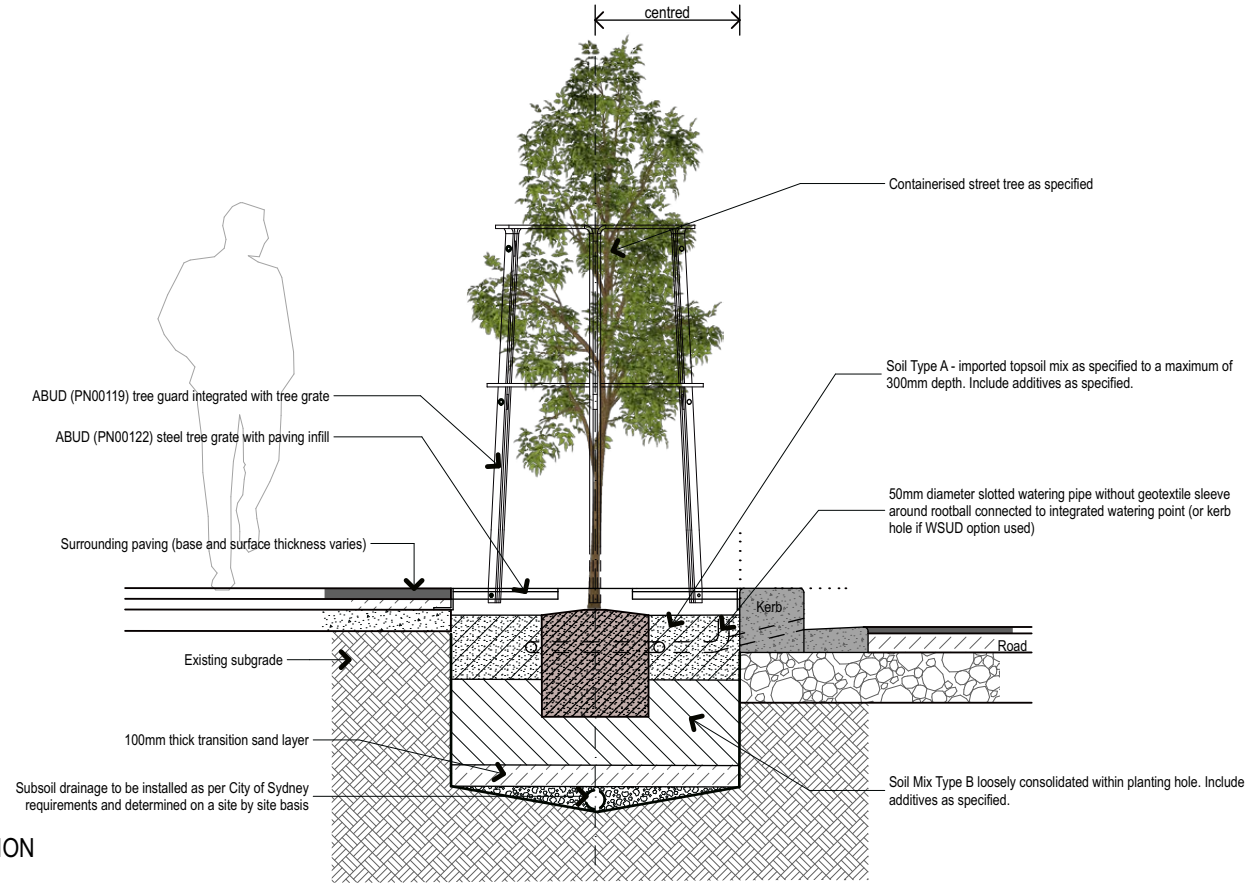
Scale 1: 25 @ A3 0 500 1000mm

TYPE 7 - TREE PLANTING IN CBD OR OTHER SPECIFIED LOCATIONS - POROUS PAVING

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.



PLAN

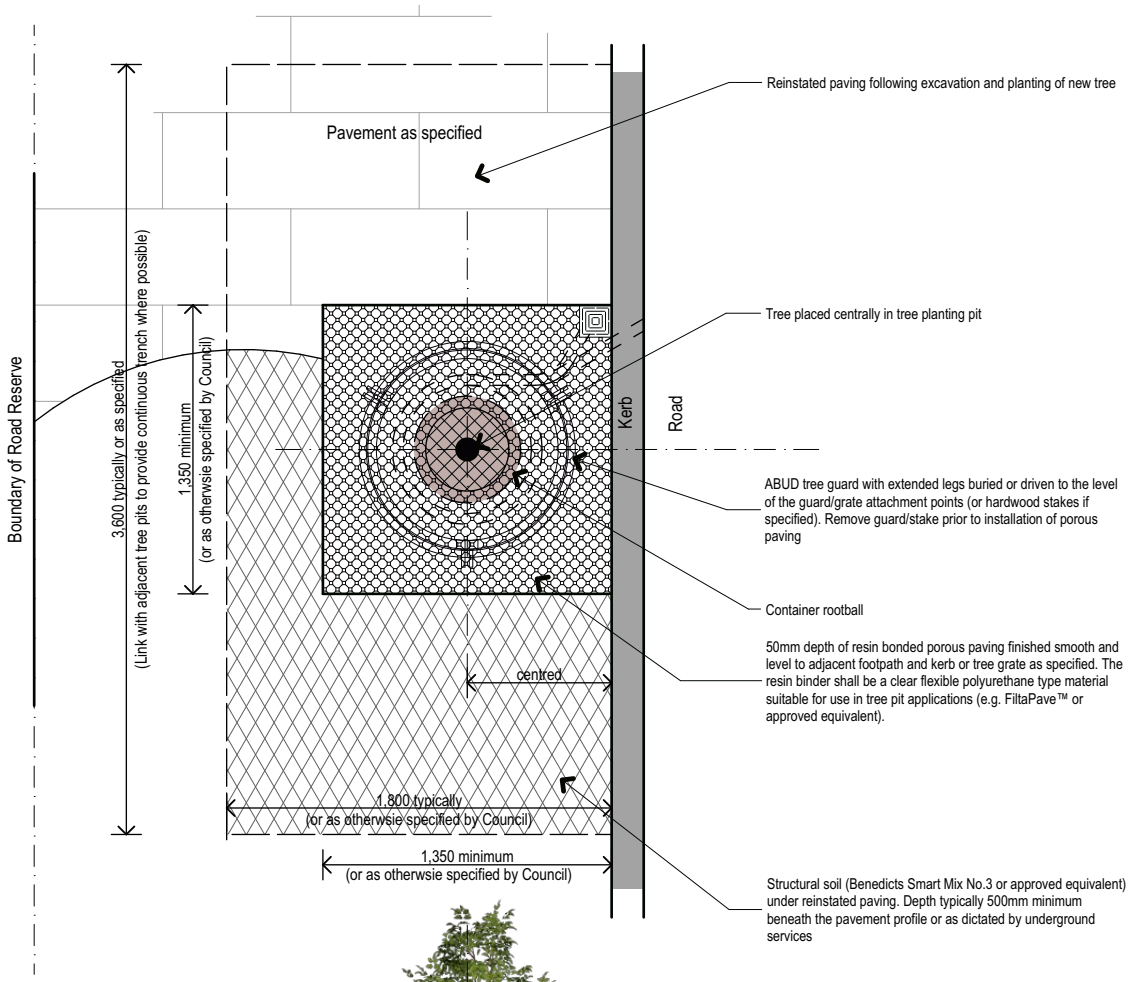


SECTION

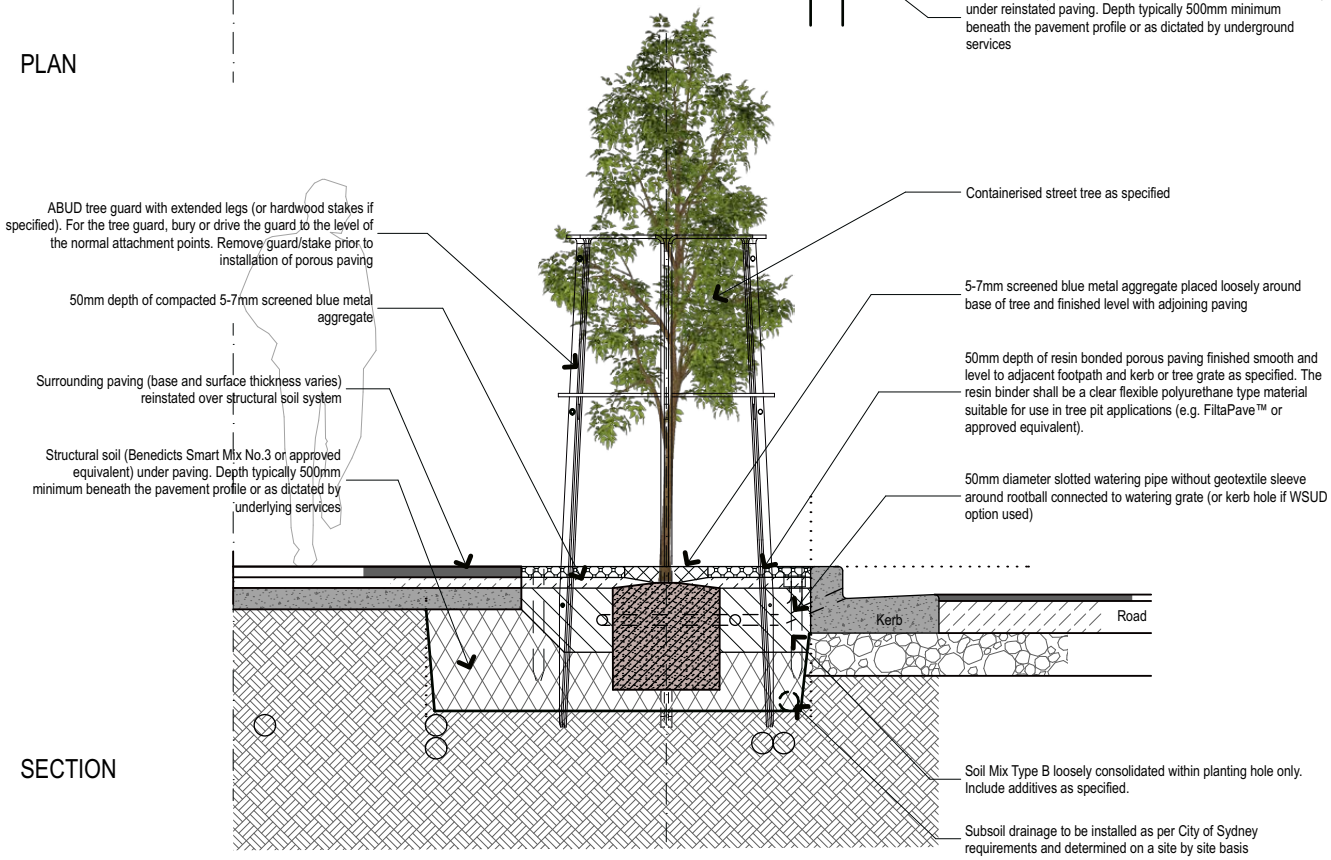
Scale 1: 25 @ A3 0 500 1000mm

TYPE 8 - TREE PLANTING IN CBD OR OTHER SPECIFIED LOCATIONS - TREE GRATE

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.



PLAN

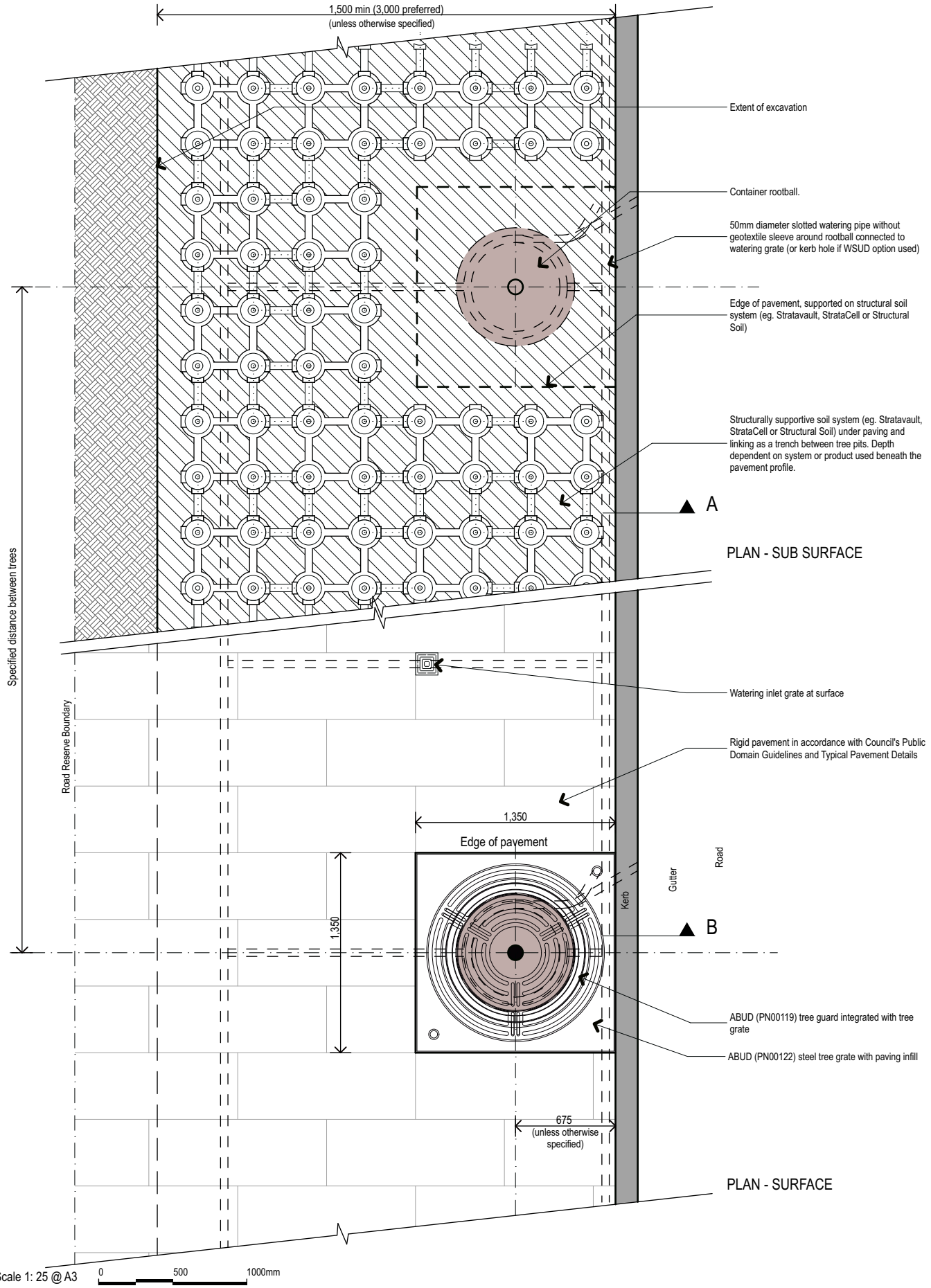


SECTION

Scale 1: 25 @ A3 0 500 1000mm

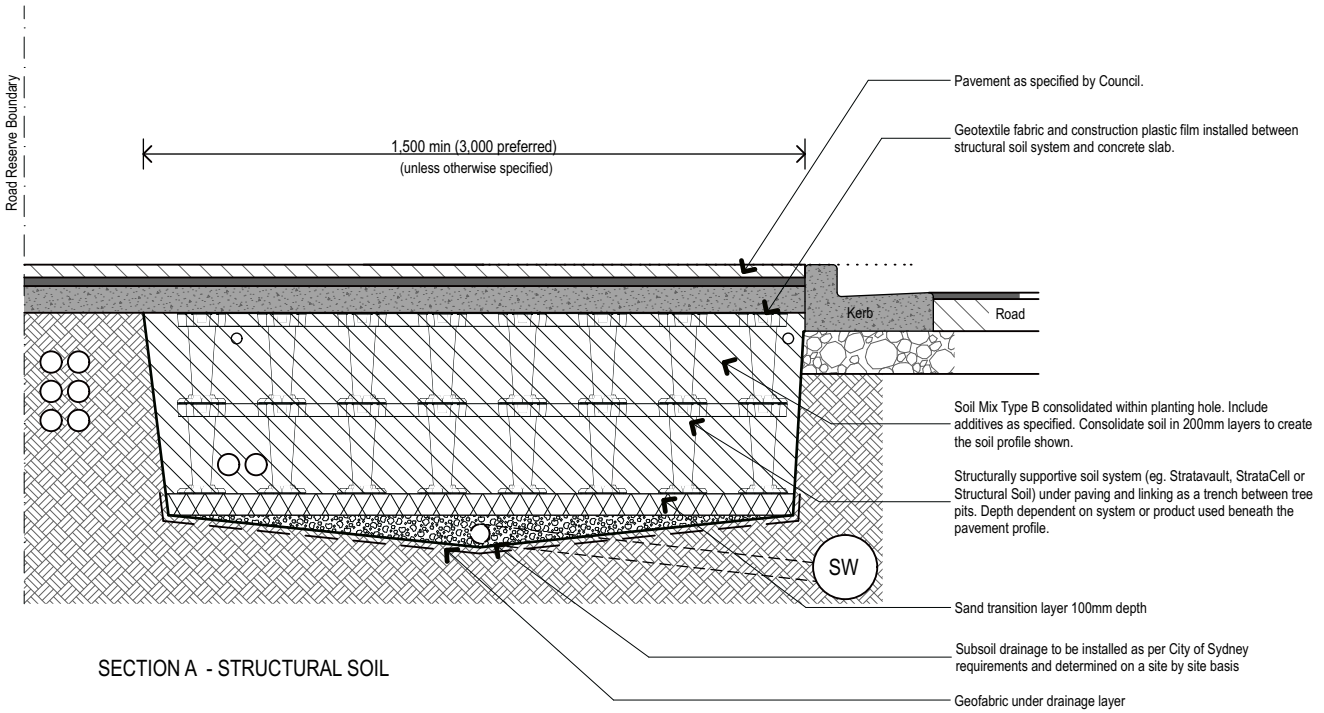
TYPE 9 - TREE PLANTING IN FULLY PAVED VERGE WITH EXPANDED SOIL VOLUME

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

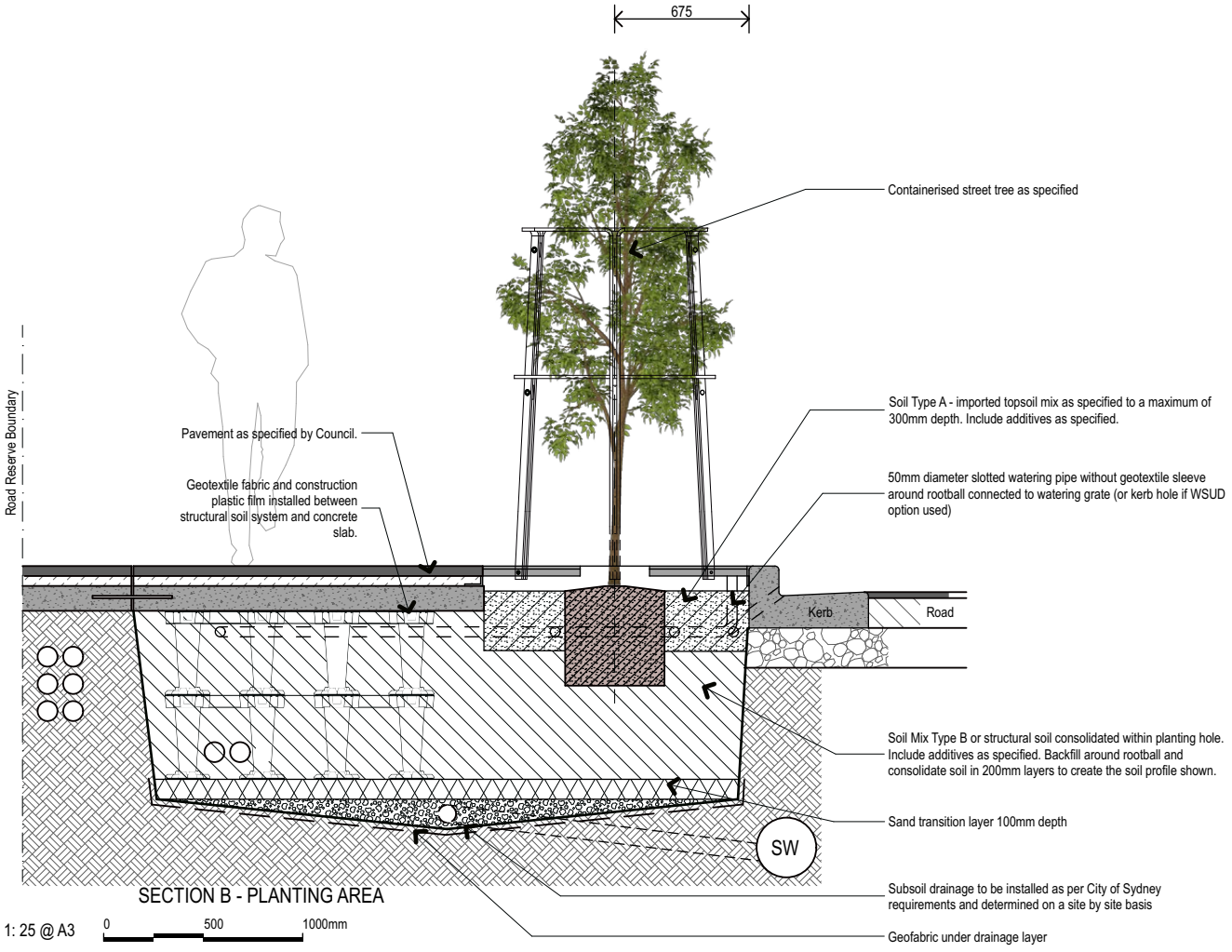


TYPE 10A - INDICATIVE TREE PLANTING WITH STRUCTURAL SUPPORT & CONTINUOUS TRENCH [PLANS]

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.



SECTION A - STRUCTURAL SOIL



SECTION B - PLANTING AREA

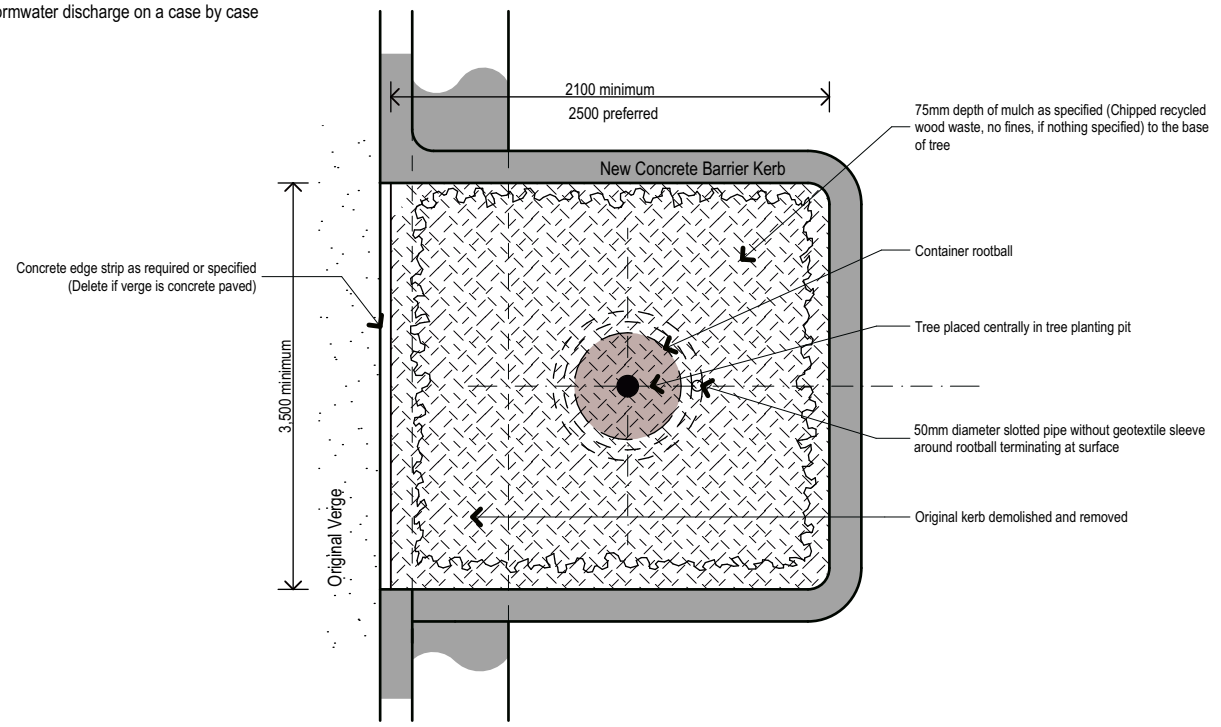
Scale 1: 25 @ A3

0 500 1000mm

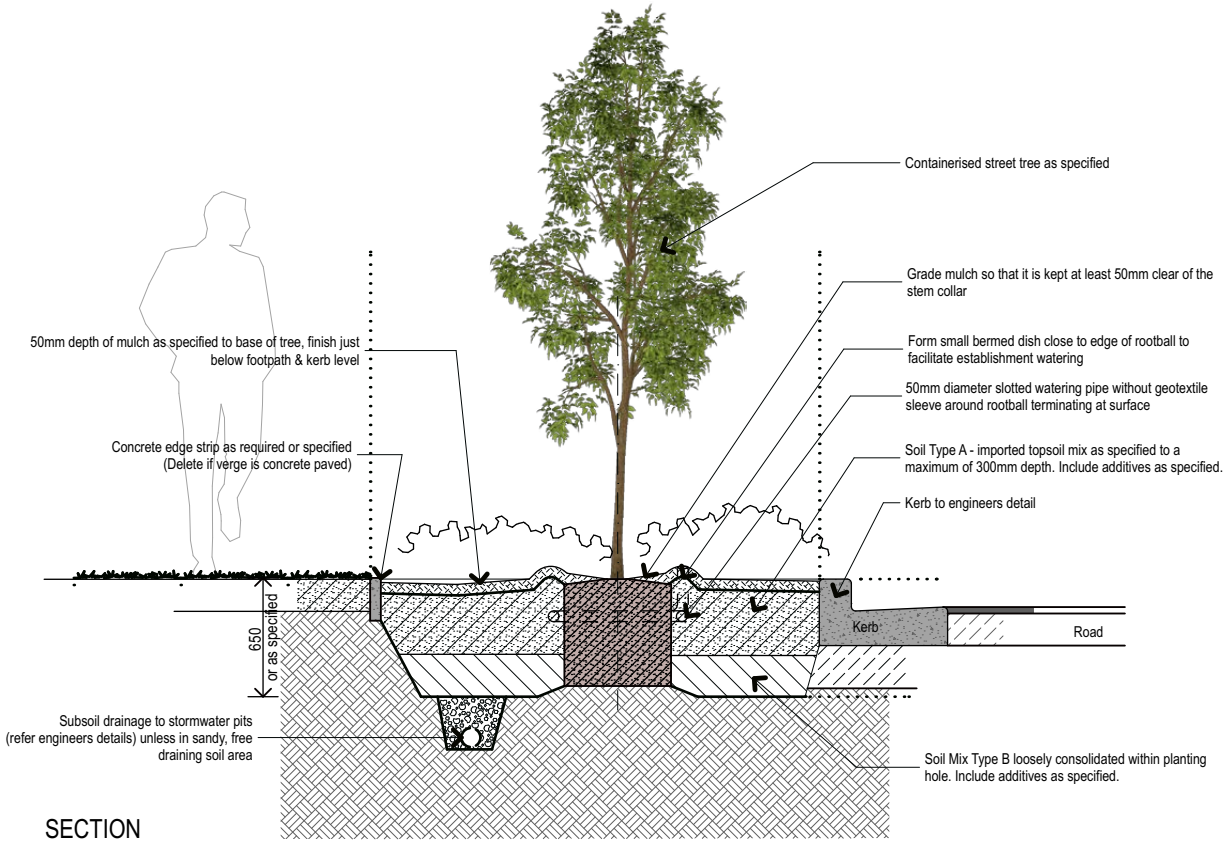
TYPE 10B - INDICATIVE TREE PLANTING WITH STRUCTURAL SUPPORT & CONTINUOUS TRENCH [SECTIONS]

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

NOTE 2:
All blister and kerb extension details are to be verified for adequate drainage and existing gutter stormwater discharge on a case by case basis.



PLAN



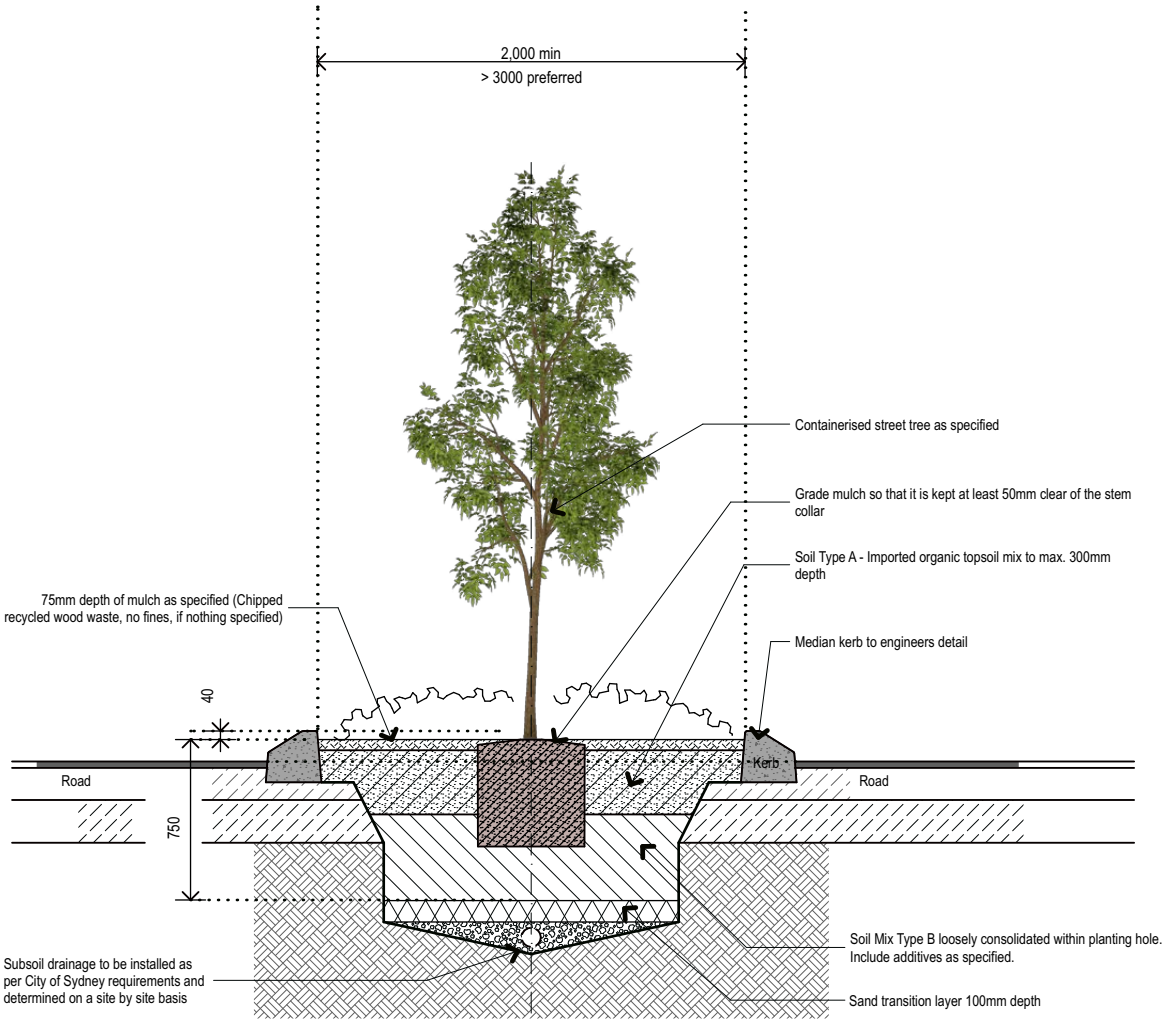
SECTION

Scale 1: 25 @ A3 0 500 1000mm

TYPE 11 - INDICATIVE TREE PLANTING IN-ROAD BLISTER

NOTE 1:
All details are to be read in conjunction with any site specific DA conditions or Council issued Contract Documentation.

NOTE 2:
All median details are to be verified for adequate drainage and soil depths on a case by case basis.



Scale 1: 25 @ A3 0 500 1000mm

TYPE 12 - INDICATIVE TREE PLANTING IN-ROAD MEDIAN