DCI15/17 DRAFT URBAN FOREST STRATEGY (D17/88135)

Director City Infrastructure

Open Space and Street Cleansing

Executive Summary

The draft Urban Forest Strategy 2017-2027 (UFS), (Attachment 1), will guide the strategic direction of the management of Moreland's urban forest, aiming to create a municipality where healthy trees and vegetation are a core part of the urban environment. The UFS builds upon and replaces the Moreland Street Landscape Strategy 2012-2022 (MSLS), by setting targets for vegetation cover and tree canopy, tree diversity, and improving the health of the urban forest while adapting to climate change and improving soil health.

In summary the City of Moreland's:

- Overall vegetation canopy from the urban forest is 14%;
- Public land contributes 5% of total municipal urban forest cover; and
- Private tree canopy has declined by 24% since 2005.

The UFS sets a strategic direction for enhancing and protecting vegetation in both the public and private realm, while including technical documents such as a Tree Protection Guide, a Nature Strip Planting Guide and a Street Tree Planting Plan. The last document includes a spatial and technical street tree planting program that complements the UFS and guides the strategic planning and planting of Moreland's street trees.

The UFS aims for a 50% increase of canopy coverage within the public realm by 2030, through the strategic planting of larger canopy trees within streetscapes, parks and natural resource management areas.

Recommendation

Council resolve to:

1. Endorse the Draft Urban Forest Strategy 2017 - 2027 for community consultation between 13 April 2017 to 15 May 2017.
2. Receive a further report at a future Council meeting, highlighting community feedback and presenting the final strategy for adoption.
3. Prepare a summary document once the final strategy is adopted.

REPORT

1. Policy Context

Moreland Street Landscape Strategy 2012-2022 (MSLS) Action:

- Develop a street planting plan for all streets of Moreland and align annual tree planting program to equitably and sustainably plant according to a prioritised planting plan;
- Develop a street management plan based on the tree maintenance risk management requirements including the outcomes of the street tree inventory, use of the asset management system and coordinated with the implementation for tree renewal programs;
- Develop and implement a community education program on the value of urban vegetation, including a targeted program for tree renewal; and
- Use the street tree inventory data to assess and/or set future targets for canopy cover, species and age diversity, proportion of indigenous trees within and across Moreland's urban forest, and potentially for sequestering carbon.

Moreland Open Space Strategy:

- Goal 1: Strategy 5 - Protect the value and amenity of existing and new open space and street landscapes.
- Goal 4: Strategy 2 - Increase tree canopy and improve tree health to create an urban forest.
- Monitor and develop a program to increase the extent of tree canopy in Moreland.
- Establish a Park Tree Management Program to conserve, enhance, manage and sustain the health and longevity of trees in parks and reserves.
- Review, update and continue to implement Council's Street Landscape Strategy.
- Ensure landscapes are linked throughout the municipality for amenity and environmental needs.

Additional Council policies and strategies that are directly related to this report include:

- Health and Wellbeing Plan;
- Urban Heat Island Effect Action Plan,
- Water Map 2020;
- Zero Carbon Evolution Strategy;
- Play Strategy; and
- Pedestrian Strategy

2. Background

At the October 2015 Council meeting (DCI41/15), Council resolved to endorse the approach of creating the Moreland Urban Forest Strategy by including a review of the current Moreland Street Landscape Strategy and creating links to existing strategies.

There is strong evidence that improving urban greening through the planting of trees and improving the general urban forest, contributes to liveability, community health and wellbeing, biodiversity, higher property values, asset protection, amenity values and provides opportunities for connecting with nature, something that is often perceived to be missing in urban areas. This vegetation also provides critical ecosystem services such as:

- Air and water filtration;
- Shelter;
- Shade;
- Habitat;

- Oxygen;
- Carbon removal;
- Stormwater abatement; and
- Nutrient cycling.

Over the past two decades Moreland's urban forest has been affected by extreme weather events including extended dry periods and storm events as well as urban consolidation. At the same time, the community are increasingly calling for more action to improve the amenity of streetscapes, increase vegetation cover, reduce the impact of the urban heat island effect and improve the protection and management of existing vegetation.

In response, Council has developed the draft Urban Forest Strategy (UFS), **(Attachment 1)** to deliver practical measures that guide the sustainable planning, planting, management, resourcing and protection of vegetation across Moreland. Urban forest refers to all trees and other vegetation in public and private spaces and includes; street and park trees, front and backyard trees, grasslands, wetlands, nature strips, community gardens, balcony plants, and green roofs and walls. Moreland's UFS sets out clear actions and targets that will help us to achieve our vision of transforming Moreland into a municipality where healthy trees and vegetation are a core part of the urban environment.

Key messages from the Strategy include:

- Between 2005 and 2016, overall vegetation canopy cover from the urban forest has declined from 15.6% to 14.2% despite growth in the contribution of Council tree canopy from 3.5% to 5%.
- Urban consolidation has contributed to a 24% decline in private tree canopy from 12% to 9% between 2005 and 2016.
- Between 2005 and 2016, canopy cover from street trees has risen from 15% to 19% in total area, contributing 2.4%, of the entire municipal canopy coverage (up from 1.9% in 2005; equivalent to a 26% increase).
- Between 2005 and 2016, canopy coverage in parks has risen from 12% to 19% in total area, contributing 2.6%, of the entire municipal canopy coverage (up from 1.6% in 2005 or a 63% increase).
- Canopy from street and park trees make up in total 5% of Moreland's land area.
- The strategic planting of larger canopy trees will increase the amenity values of street trees from the current $270 million to over $1.2 billion by 2050 and deliver over $4.6 million in direct environmental benefits annually.
- Canopy analysis identified a further 14% plantable opportunities on private land and 15.6% plantable opportunities in Council parks and streets.
- Practical tree canopy saturation of Moreland's streets and parks is limited and could only achieve maximum canopy coverage of 14% and 6.6% respectively or 20.6% in total. This suggests a focus needs to occur on private realm tree canopy also.

The 2016 audit of street trees found:

- More than 60,000 street trees.
- Overall health of the forest is good.
- Street trees are worth an estimated $270 million in amenity value and provide the community with $361,073 worth of environmental benefits annually.
- An over reliance on small, short-lived trees (e.g. Callistemon).
- Low species diversity (66% Myrtaceae Family).
- High mortality rate of new plantings (average 20%).
- Eighty five percent of Moreland's streets are without any natural shade.

3. Issues

Canopy opportunity

Council is well placed to make strategic decisions to realise the social, economic and environmental benefits of the UFS by:

- Increase awareness and engagement opportunities with the community, developers and Council staff around the benefits and value of Moreland's urban forest, including supporting community greening initiatives in the public and private realm;
- Doubling Moreland's public realm urban forest canopy cover by 2030 through strategically planting larger, healthier canopy trees with a longer life expectancy;
- Shift the focus of targets from outputs to outcomes, including canopy cover, net gain, overall forest health and community satisfaction;
- Establishing a working group to review a range of mechanisms and actions to provide protection of existing private vegetation and introduce new programs to encourage planting on private land;
- Focus on quality outcomes requiring a reduction in annual street tree planting from 5,000 to 3,500 per annum, allowing for increased maintenance of newly planted trees. This will combat extreme weather conditions, vandalism and natural stock loss, resulting in better canopy coverage outcomes in the future due to a shift to larger canopy trees being planted. A lower annual planting target of 3,500 trees provides flexibility to increase the maintenance of 10,500 street trees during the three year establishment period. Most metropolitan Councils only plant between 1,000 to 2,000 street trees per annum;
- Extending planting opportunities across all of the Urban Forest, not just streetscapes by increasing park plantings and revegetation of our creeks and waterways with a further 750 trees, totalling 4,250 trees in total per annum;
- Continue to resource Council's tree planting, establishment and maintenance programs to ensure quality outcomes that minimise and mitigate risks to the community and ensure a healthy urban forest;
- Adjust species selection and maintenance practices to ensure future climate resilience of the urban forest; and
- Integrate greening opportunities with all relevant Council capital works projects and initiatives to ensure the UFS is complementary in supporting community, environment and economic wellbeing.

The implementation of the recommendations and adoption of the guidelines included in this Strategy could result in the doubling of Moreland's urban forest canopy contribution in the public realm from 5% in 2016 to 10% by 2030.

Resourcing implications

Decline in private vegetation is effectively resulting in a shift in responsibility for maintaining the urban forest from the private to the public realm (Council land). The proposed growth in public canopy will have resourcing implications for Council by potentially increasing:

- Regulatory pruning requirements for maintaining electrical line clearance;
- Programed pruning works and storm damage;
- Insurance claims for infrastructure damage caused by trees (roots, limb drop);
- Levels of service for street cleansing, especially during autumn; and
- Complaints about overhanging limbs on private property.

These will be assessed and monitored throughout the 10 year life of this strategy.

Timing

A healthier outcome for Moreland's urban forest will take at least 10 years to produce tangible, visible benefits and is the duration of this strategy.

Human Rights Consideration

The implications of this report have been assessed in accordance with the requirements of the Charter of Human Rights and Responsibilities.

4. Consultation

There are 3 components to the public engagement and communication on the Urban Forest Strategy:

- Background discussions with the public have taken place to better understand their concerns, interests and values in regard to Moreland's urban forest through proactive community engagement at over 17 events and occasions. These include municipal festivals in Coburg and Fawkner, Moreland Energy Foundation Limited program events and presentations to citizens.
- 4 weeks consultation on the draft plan is scheduled from 13 April 2017 to 15 May 2017, following Council endorsement of the draft strategy. This will include public forums at Councils Neighbourhood Houses.
- Consultation was sought from staff during the development of this draft strategy from relevant Council departments including City Development, Strategic Planning, Urban Design, Places, Open Space Maintenance, Roads, Compliance, Risk, Strategic Transport, Street Cleansing, Social Policy, Waste, Asset Protection and ESD.

5. Officer Declaration of Conflict of Interest

Council Officers involved in the preparation of this report have no Conflict of Interest in this matter.

6. Financial and Resources Implications

The UFS does not commit Council to new unfunded projects. Instead, it emphasises improving the efficiency and productivity of current vegetation management to improve outcomes within existing budgetary constraints. The important work and analysis contained within the UFS offers a base to develop funding applications and explore opportunities with identified partners for grants.

The implementation of the UFS has resourcing implications arising from the growing tree canopy in the public realm. This will be reviewed in 2021 and 2026, to assess the implications on Council operations.

7. Implementation

Following the community consultation period, the UFS will be presented at a future Council Meeting for formal endorsement.

Attachment/s

1⇩ Draft Urban Forest Strategy 2017 - 2027 D17/90921

Moreland City Council

MORELAND CITY COUNCIL

DRAFT URBAN FOREST STRATEGY 2017-2027

Moreland values the important contribution of trees and vegetation in making the municipality a vibrant place to live, work and visit; and is committed to protecting, enhancing and managing our urban forest into the future

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1

The two images below provide a contrasting visualisation of the significant role of the urban forest in defining streetscape character, The Grove, Coburg.

2

MAYOR'S FORWARD

VISION STATEMENT

To promote and encourage the transformation of Moreland into a municipality where healthy trees and vegetation are a core part of the urban environment

Acknowledgements

Moreland's urban forest strategy acknowledges the Wurundjeri as the traditional owners of the land. We acknowledge their elders past, present and future. Council is committed to building a trusting, collaborative and supportive relationship with indigenous groups, and to respecting identified Aboriginal sacred sites and special places. We acknowledge that we have much to learn and plenty of work to do if we are to repair the poor state of land that was occupied by and forcibly taken away from the Wurundjeri who had cared for the land for over 40,000 years. For this acknowledgement to be meaningful, Moreland will need to not only improve its protection of important cultural and environment sites but improve our engagement with Wurundjeri through projects such as the Murnong Festival that acknowledge the strength and significance of ongoing access to, and celebration of, land and country.

Moreland's urban forest strategy was developed by Moreland City Council's Open Space Unit with technical contributions and analysis undertaken by: Enspec for the iTree Eco assessment, iTree Canopy analysis, street tree inventory, tree selection calculator and vacant site mapping; Greenspace Consultant for the landuse and canopy change analysis; and, Urban Forest Consulting who reviewed the draft strategy. Special thanks to Craig Hallam, Chris Spencer, Craig Hinton, Joe Kaspar and Meg Caffin as well as Brett Hudd and Nathan Milesi for their contributions to the body of work behind this Strategy and Alex English, project officer.

EXECUTIVE SUMMARY

There is strong evidence that improving urban greening through the planting of trees contributes to liveability, community health and wellbeing, higher property values, asset protection, amenity values and provides opportunities for connecting with nature, something that is often perceived to be missing in urban areas. This vegetation also provides critical ecosystem services such as air and water filtration, shelter, shade, habitat, oxygen, carbon sequestration, stormwater abatement and nutrient cycling.

Over the past two decades Moreland's urban forest has been affected by extended dry periods, urban consolidation, inadequate protection during construction, and constrained levels of maintenance. At the same time, the community are increasingly calling for more action to improve the amenity of streetscapes, increase vegetation cover, reduce the impact of the urban heat island effect and improve the protection and management of existing vegetation.

In response, Council has developed this Urban Forest Strategy to deliver practical measures that guide the sustainable planning, planting, management, resourcing and protection of vegetation across Moreland. The term urban forest refers to all the trees and other vegetation in public and private spaces and includes, for example, street and park trees, front and backyard vegetation, grasslands, shrubs, wetlands, nature strips, balcony plants, and green roofs and walls.

Background work undertaken in preparation of this Strategy has improved our understanding of the current urban forest, its challenges and identified opportunities for greening across the municipality. Key findings include:

- Moreland has a relatively young urban forest providing 14% tree canopy cover comprised of 9% private trees and 5% public trees (park trees, 2.6%; street trees, 2.4%). This compares with 17.3% tree canopy cover in Darebin and 18.5% in Yarra.
- Between 2005 and 2016, overall canopy cover has declined from 15.6% to 14.2%. Urban consolidation is the main cause of the decline in private realm canopy from 12% to 9%.
- During the same period, canopy cover from street trees and park trees has grown by 26% and 63% respectively, albeit from a low base.
- Despite the strong medical and scientific evidence base about the benefits of trees, approximately 85% of Moreland's streets are without any natural shade.
- It is estimated that Moreland has over 130,000 trees in the public realm and a further 250,000 trees in the private realm.
- 95% of the current tree population assessed to have good health.
- Between 2006 and 2017, Council has planted over 40,000 street trees.
- Moreland's 60,000 street trees are worth an estimated $271 million in amenity value and provide the community with $361,073 worth of environmental benefits annually.
- Moreland's street trees store over 11 tonnes of carbon dioxide (CO_2) and remove a further 912 tonnes annually.
- An over reliance on small, short-lived trees limits the potential canopy and benefits of the urban forest.
- The optimised planting of larger canopy trees would increase the amenity values of street trees to over $1.2 billion by 2050 and deliver over $4.6 million in direct environmental benefits annually.
- There are 394 different species of street trees with a mix of exotics (26%), natives (69%) and indigenous (5%) vegetation.
- 66% of tree species are from Myrtaceae Family; 26% of the forest is dominated by the genus, Callistemon, and 21% by Eucalypts
- Council's tree maintenance and resourcing have struggled to keep up with the compounding

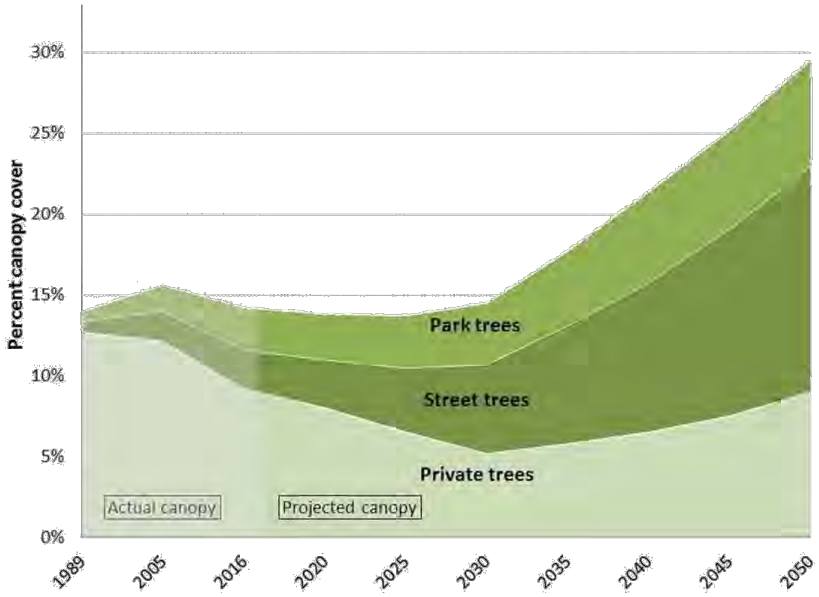
effect of the 5,0000 annual planting targets resulting in 20% average annual fatality rates

An urban forest strategy for Moreland will need to address not only these challenges but additional considerations including: species selection and placement; the relationship between vegetation and air quality; soil health; water demand and supply options; partnerships with road and footpath works; working with utilities; risk management; asset renewal and management; growing maintenance requirements and resourcing implications; public-private tensions; managing community expectations and engagement; integrated management; and skills development.

This Strategy recommends a significant shift in approach to management and resourcing to realise a vision to promote and encourage the transformation of Moreland into a municipality where healthy trees and vegetation are a core part of the urban environment. It aims to realise this vision by nurturing a healthy, attractive and diverse urban forest that uses traditional and innovative greening solutions to improve the health and wellbeing of current and future generations through the doubling of vegetation canopy by 2050.

In practice, this requires the planting and resourcing of larger canopy trees (including deciduous species) to improve shade, cooling, biodiversity, energy savings, air quality, health benefits and amenity.

This Strategy has identified a further 30% of Moreland's land area where vegetation canopy could potentially be planted, including a further 14% of plantable opportunities on private land and 15.6% of plantable opportunities on public land (see canopy cover figure). The practical saturation of our streets and parks could achieve 14% and 6.6% respective canopy cover.



Actual and Projected Tree Canopy Cover under the implementation of the Urban Forest Strategy

Successfully achieving this vision should provide a balance to the highly urbanised environment of the municipality and will directly impact the daily lives of residents and visitors as well as improve the liveability of Moreland in the long term.

Responsibility for implementing this strategy goes beyond Moreland City Council's management of its parks, reserves and streetscapes but includes contributions from the whole community.

6

The Strategy recommends Moreland City Council and the community commit to the following objectives:

- Introduce strategies to protect and enhance the urban forest in both the public and private realm through a review of the Planning Scheme, Structure Plans and Local Law to ensure vegetation is accepted as a core element of the desired neighbourhood character;

- Implement 5 year planting and maintenance plans, which ensures a comprehensive and consistent approach to improving amenity, liveability, biodiversity and sustainability;
- Sustainably resource Council's tree planting, establishment and maintenance programs to ensure quality outcomes that minimise and mitigate risks to the community and ensure a healthy urban forest;
- Due to climate conditions and a need for quality outcomes, a more sustainable annual tree planting figure of 4,250 across the municipality is recommended to meet the proposed canopy targets.
- Plant larger, longer lived canopy trees where appropriate;
- Adjust species selection and maintenance practices to ensure future climate resilience of the urban forest;
- Integrate greening opportunities with all relevant Council capital works projects and initiatives to ensure the strategy complements other aligned organisational plans and strategies supporting community, environmental and economic wellbeing;
- Increase awareness and engagement opportunities with the community, developers and Council staff around the benefits and value of Moreland's urban forest, including supporting community greening initiatives in the public and private realm; and,
- Complement other aligned organisational plans and strategies that support community, environment and economic wellbeing.

According to Victoria's Local Government Act (1989), the primary function of councils is "to endeavour to achieve the best outcomes for the local community having regard to the long-term and cumulative effects of decisions". Short-term action on these recommendations is critical for the implementation of the Urban Forest Strategy because most vegetation takes over a decade to start delivering the benefits identified above.

Moreland has shown that it has the capacity and resources to intervene and implement appropriate and positive measures to cool its streets and neighbourhoods through the provision of shade from healthy street trees. This Urban Forest Strategy requires Council and the community take the next important step of ensuring vegetation is no longer a peripheral concern but a core part of daily life in Moreland.

TABLE OF CONTENTS

Contents

EXECUTIVE SUMMARY **5**

TABLE OF CONTENTS **8**

LIST OF FIGURES **9**

LIST OF TABLES **10**

1. INTRODUCTION: A HEALTHY & RESILIENT URBAN FOREST 1
2. VISION 3
3. BENEFITS OF THE URBAN FOREST 4
4. MORELAND'S URBAN FOREST 11
5. DIVERSITY 15
6. CANOPY COVER 20
7. MEASURING THE VALUE OF THE URBAN FOREST 27
8. CHALLENGES 29
9. PLANTING OPPORTUNITIES 38
10. NEIGHBOURHOOD CHARACTER AND THE URBAN FOREST 42
11. AN OPTIMAL TREE PLANTING SCENARIO 51
12. IMPLEMENTATION PLAN & FUNDING 65
13. RELATIONSHIP TO KEY COUNCIL STRATEGIES AND POLICIES 77

GLOSSARY 81

REFERENCES AND ENDNOTES **84**

REFERENCE DOCUMENTS **89**

1. STREET TREE PLANTING PLAN 89
2. TREE PROTECTION GUIDE 89
3. MORELAND HABITAT STREETS AND BUFFER ZONES MAP 89
4. NATURE STRIP GUIDELINES 89

REFERENCE DOCUMENT 1 –STREET TREE PLANTING PLAN **90**

1. STREET TREE ISSUES AND IMPROVEMENTS 91
2. PLANNING FOR MORELAND'S FUTURE URBAN FOREST: AIMING FOR QUALITY OUTCOMES 92
3. CURRENT STREETSCAPE PLANTING PROGRAMS 94
4. TREE SELECTION 99
5. TREE SPECIES LIST 101
6. SITE SELECTION 104
7. PROPOSED STREET TREE PLANTING PROGRAM 107
8. NEIGHBOURHOOD PRECINCTS 111
9. COMMUNITY CONSULTATION 114
10. STREETSCAPE DESIGN 117
11. URBAN SPACE CONSTRAINTS FOR TREES 119
12. STREETSCAPE TREE PLACEMENT OPTIONS 124
13. VACANT STREETS AND PROPOSED PLANTING STREETS 125
14. SPECIES RATINGS & CALCULATOR 126
15. SOIL HEALTH GUIDELINES 128
16. PRUNING 137
17. MANAGEMENT OF PEST, DISEASE, ANIMAL AND WEED SPECIES 140
18. METHODS 144

REFERENCE DOCUMENT 2 - TREE PROTECTION GUIDE **157**

1. TREE REMOVAL 158
2. PARK TREE PROGRAM 161
3. TREE REMOVAL AND ALLERGIES 161
4. SIGNIFICANT TREES AND VEGETATION 162
5. PROTECTION OF TREES DURING DEVELOPMENT 163

6. COMPETING INFRASTRUCTURE AND SERVICES 165
REFERENCE DOCUMENT 3 - MORELAND HABITAT STREETS 166
REFERENCE DOCUMENT 4 – NATURE STRIP GUIDELINES 167

LIST OF FIGURES

Figure 1. The benefits of trees 4
Figure 2. The environmental services provided by a large urban tree 6
Figure 3. Priority steps for achieving cooling benefits from the implementation of an urban forestry (Urban Green Infrastructure, UGI) program 8
Figure 4. Ground based thermal images of Moreland streetscapes, Celsius 9
Figure 5. Relationship between a tree's leaf area, tree size and the social, economic and environmental benefits 10
Figure 6. Current Moreland street tree locations map with Anstey precinct inset 12
Figure 7. Tree diversity: most common street tree genera in Moreland 15
Figure 8. Tree diversity: Most common street tree families in Moreland 16
Figure 9. Tree diversity: Most common street tree species in Moreland 16
Figure 10. The estimated life expectancy of Moreland's urban forest 18
Figure 11. Summary of the estimated health of Moreland's urban forest 19
Figure 12. Moreland tree canopy by land area, 2005-2050 20
Figure 13. Canopy cover (%) for selected Victorian Local Government Areas 21
Figure 14. Change in tree canopy types as a proportion of Moreland land area, 1989, 2005 & 2016 22
Figure 15. 2016 Suburb tree canopy cover proportions by street, park and private land, percentage 23
Figure 16. Canopy cover change for Moreland suburbs (SA2) between 2011 and 2016 by land-use category (% change) 25
Figure 17. Urban forest canopy cover change in Moreland including projected canopy cover under the Urban Forest Strategy, 2017-2050 26
Figure 18. Air pollution removed by Moreland's street trees every year, kg 28
Figure 19. Carbon dioxide (CO2) removed and stored by Moreland's street trees every year, cars and tonnes 28
Figure 20. Moreland land cover types including opportunities for tree planting 39
Figure 21. Current vacant plantings locations map across Moreland 41
Figure 22. Actual and projected tree canopy cover under the implementation of the Urban Forest Strategy 52
Figure 23. Relationship between the trunk diameter and canopy cover contribution of Moreland's street trees 54
Figure 24. Comparison of environmental benefits between the current and optimal street tree planting program 56
Figure 25. Current (pink dots) and Future (green dots) Optimal Canopy Cover Map 57
Figure 26. Chapman Avenue Glenroy in 2016 59
Figure 27. Visualisation of Chapman Avenue Glenroy in 2050 59
Figure 28. Dawson Street Brunswick in 2016 60
Figure 29. Visualisation of Dawson Street Brunswick in 2050 60
Figure 30. New Road Glenroy in 2016 61
Figure 31. Visualisation of New Road Glenroy in 2050 61
Figure 32. Nicholson Street Brunswick in 2016 62
Figure 33. Visualisation of Nicholson Street Brunswick in 2050 62
Figure 34. Sages Road Glenroy (Gowrie Station) in 2050 63
Figure 35. Visualisation of Sages Road Glenroy (Gowrie Station) in 2050 63
Figure 36. Sydney Road Fawkner in 2016 64
Figure 37. Visualisation of Sydney Road Fawkner in 2050 64
Figure 38. Priority implementation action matrix 66

Figure 39. Urban Forest Strategy implementation program 67
Figure 40. Relationship between Moreland's Urban Forest Strategy and other council policies and strategies 80
Figure 41. Moreland City Council heat vulnerability and UHI priority areas 96
Figure 42. Prioritising street tree shading according to the street canyon ratio of height to width (Norton *et al.* 2015) 98
Figure 43. Idealised streetscape planting to maximise passive and active benefits of street trees 104
Figure 44. Typical streetscape planting design options 117
Figure 45. Typical streetscape and intersection planting design options 118
Figure 46. Cross-Section of High Street In-Road Passive irrigation Tree Pit Design 121
Figure 47. Minimum tree (crown lifting) clearances over footpaths 122
Figure 48. Minimum tree (crown lifting) clearances over a bike path 123
Figure 49. Minimum clearances over a primary or secondary connector road 123
Figure 50. Typical road reserve planting 124
Figure 51. Road reserve with no footpath 124
Figure 52. Footpath between road and road reserve 124
Figure 53. Narrow road reserve 124
Figure 54. Raised planting bed 124
Figure 55. In-road planting 124
Figure 56. Contrasting physical, chemical and biological materials of forest soils and urban soils 128
Figure 57. Contrasting practices for spreading mulch 130
Figure 58. Common plant pathogens present in Moreland 131
Figure 59. Ideal bulk density and compaction ranges 132
Figure 60. Pneumatic injection machinery can increase soil organic matter 132
Figure 61. Prefabricated structural soil examples: Deep Root Silva Cell®; CityGreen StrataCell®; Green Blue Stratavault® 133
Figure 62. Stockholm tree planting pit method 134
Figure 63. Vertical mulching method 135
Figure 64. Vertical mulching methods: grid and concentric patterns 136
Figure 65. Schematic of the use and function of iTree Eco 146
Figure 66. iTree Eco Samples Tree Location Map 148
Figure 67. Vehicle crossing tree inspection and results, February 2013 – February 2016 164

LIST OF TABLES

Table 1. Current street tree population and contribution to canopy cover by suburb 22
Table 2. Environmental and amenity values of current street trees prior to 2016 planting season 27
Table 3. Simplified decision matrix for managing trees in the urban forest during climate change 30
Table 4. Distribution of land-use areas for 8 Moreland suburbs (SA2), 2016 32
Table 5. Street Trees and Vacant Planting Sites 38
Table 6. Current Street Trees with Vacant Sites by Suburb and Ratio, 2016 39
Table 7. Preferred Plants for Moreland Green Façades and Roofs 48
Table 8. Average tree canopy cover for Moreland's top ten tree genera 51
Table 9. Current and 2050 canopy cover projections under optimised saturation and more realistic scenarios 53
Table 10. Environmental and amenity values of current and future street trees at maturity in 2050 55
Table 11. Estimated Environmental and Amenity Value of Vacant Sites 56
Table 12. Street Tree Canopy Cover Projections in 2050 as a Proportion of Land Area by Suburb 57
Table 13. Urban Forest Strategy key performance indicators (KPI) 65
Table 14. Urban Heat Island priority areas for street tree planting in Moreland 97
Table 15. Urban heat island priority plantings in vacant sites requiring a designed outcome 97
Table 16. Highest rated tree species based upon all attributes 99

Table 17. Annual tree planting budget, 2015-16 107
Table 18. Tree Planting Establishment Costs, 2015-16 107
Table 19. Projected current and proposed tree planting programs 108
Table 20. Annual tree planting programs 108
Table 21. Projected timeframes for current and proposed street tree planting programs reaching vacant site saturation by 2021 109
Table 22. Transport safety clearance guidelines 120
Table 23. Vacant Streets 125
Table 24. Potential Planting Streets 125
Table 25. Essential plant nutrients 129
Table 26. Street tree data sets 144
Table 27. Estimated street tree status based upon sample data 144
Table 28. iTree AIM areas (200 trees) 146
Table 29. Non iTree AIM areas (250 trees) 146
Table 30. Data fields used for iTree Eco sampling 148
Table 31. Canopy cover classes and status 150
Table 32. iTree Canopy standard errors 151
Table 33. Distribution of by land-use areas for each suburb (SA2), 2011-2016 151
Table 34. Changes in hard surface area between 2011 and 2016 by land-use category, Moreland LGA 152
Table 35. Land cover estimates by type including greenspace and hard surfaces for 5 suburbs, 2016 153
Table 36. Land-use categories from *Vicdata* planning database used in the study 154
Table 37. Classification of variables 155

Community consultation program

Our urban forest will thrive best if it is valued and supported by the local community. Community custodianship of vegetation, whether it is their own garden, nature strip, a street tree, a green roof, car park vegetation, or community plantings along our waterways or train lines benefit not only the vegetation but also the broader community. At the same time, Council needs to improve community understanding of the importance and benefits of urban greening whilst encouraging residents to fear less about large trees, garden shrubs, long grass, overhanging limbs and consider autumn leaves and seed pods less problematic. It also requires Council to sustain and maintain its urban forest as living assets.

Council is undertaking a range of targeted and more general engagement and consultation activities throughout the development of the Urban Forest Strategy. These have included holding information stalls at community events (such as the Coburg Night Market, Fawkner, Gowanbrae and Glenroy Festivals and the Sydney Road Street Party), public presentations at local Neighbourhood and Community Centres, internal presentations to Council stakeholders and discussions with local school children. Once the draft Urban Forest Strategy is endorsed by Council, it will go out to the community for a formal four week consultation process from 13 April 2017 to 15 May 2017.

If you have any specific interest, concerns or questions relating to the Moreland Urban Forest Strategy, then please contact Alex English from Council's Open Space Unit on 8311 4387 or aenglish@moreland.vic.gov.au

1. INTRODUCTION: A HEALTHY & RESILIENT URBAN FOREST

It is not uncommon to hear visitors to Moreland exclaim that they know they have arrived in the municipality due to the lack of streetscape vegetation. Recent satellite and aerial images show that Moreland is not only hotter, has less vegetation and open spaces than many municipalities in Melbourne, but we know that our community is more vulnerable to climate change.[i] If we want to fulfil the vision for a sustainable Moreland that supports a resilient community living in an attractive, accessible and safe environment, then it is important that we take some important steps towards greening our municipality through shade trees and improving the provision of vegetation and nurturing our urban forest.

The term urban forest refers to all trees and other vegetation in public and private spaces and includes, for example, street and park trees, front and backyard trees, grasslands, wetlands, nature strips, balcony plants, and green roofs and walls.

Despite an extensive planting program over the past decade to increase vegetation in our parks and streets by Council and community groups, canopy cover across Moreland has declined. Urban consolidation has been the main cause of this decline through the removal of tree canopy in the private realm. Once this vegetation has been removed, it is very difficult to replace. The disappearance of the traditional backyard presents a challenge for providing canopy cover on private land.

The declining overall canopy cover highlights the divergent interest and responsibilities between the private and public realms for the protection and establishment of trees. Over the past two decades Moreland's urban forest has been constrained by not only urban consolidation, but also extended dry periods, climate change, and inadequate protection during development.

Moreland's urban forest is a significant asset to the local community and environment because it provides many critical ecosystem services such as air and water filtration, shelter, shade, habitat, oxygen, carbon sequestration, stormwater abatement, nutrient cycling and mitigation of the urban heat island effect. Our urban forest also contributes to community health and wellbeing, amenity, asset protection, property values and provides opportunities for connecting with nature, something that is often perceived to be missing in urban areas.

Council has attempted to realise many of these benefits by making the municipality greener. However, Council's over reliance on small, short lived street trees with a high failure rate amongst new plantings combined with a steady urban consolidation and concomitant loss of vegetation has resulted in a decline in overall canopy cover. Between 2005 and 2016, canopy cover across Moreland has declined 9% from 15.6% to 14.2% due to a 24% drop in private tree canopy. During the same period, canopy cover from street trees and park trees has grown by 26% and 63% respectively, albeit from a low base. As a result, the burden for managing the urban forest is shifting to the public realm to deliver these outcomes. However, because future opportunities for vegetation in the private realm are increasingly limited due to the growing footprint of the built form, new planting opportunities will need to be realised largely in the public realm if Moreland is to grow its urban forest.

In response to some of these challenges, Council has developed this Urban Forest Strategy to achieve a vision of a green, leafy Moreland that is attractive, sustainable, diverse and healthy, and which provides a pleasant environment for the community to live and work. This will be achieved through practical measures that guide the protection, planting, management and resourcing of vegetation across Moreland to ensure the urban forest delivers essential environmental, social and economic services to the community and environment.

This Urban Forest Strategy builds upon and complements Council plans and policies, notably the 2012 Street Landscape Strategy, the Health and Well Being Plan, WaterMap 2020, the Open Space Strategy, the Municipal Strategic Statement, Zero Carbon Evolution Strategy and the Urban Heat Island Effect Action Plan.

The Urban Forest Strategy is supported by several detailed reference documents that provide Council staff and the community with a range of practical documents to understand and ensure a clear and consistent approach to managing the urban forest, including:

- A Street Tree Planting Plan
- A Tree Protection Guide
- Habitat Streets
- A Nature Strip Guide

The implementation of the recommendations and adoption of the guidelines included in this Strategy could potentially result in the doubling of Moreland's urban forest canopy from 14% in 2016 to 29% by 2050. This is equivalent to a quadrupling of public realm canopy from 5% to 20% respectively.

2. VISION

To promote and encourage the transformation of Moreland into a municipality where healthy trees and vegetation are a core part of the urban environment

Council will achieve this vision for greening Moreland by nurturing a healthy, attractive and diverse urban forest that uses traditional and innovative greening solutions to double public realm canopy by 2030 to improve the health and wellbeing of current and future generations.

Council will achieve this vision for greening Moreland through the following objectives:

1. *Doubling urban forest canopy cover*
2. *Value the urban forest as a core element of our urban space*
3. *Maintain the health of the urban forest*
4. *Protect urban ecology*
5. *Manage and mitigate urban forest risks*
6. *Monitor and review progress to measure success and best practice*
7. *Strengthen community custodianship and engagement of the urban forest*

3. BENEFITS OF THE URBAN FOREST

Trees and vegetation in the urban landscapes provide many environmental, health and economic benefits. Urban trees and streetscapes are worth much more than they cost and they are the key to urban sustainability. In fact, the overall environmental and amenity benefits provided by trees within Moreland outweigh their maintenance costs by ten to one. Moreover, maintaining a healthy urban forest is a cost-effective strategy for Council to meet a range of economic, health, wellbeing and environmental targets.

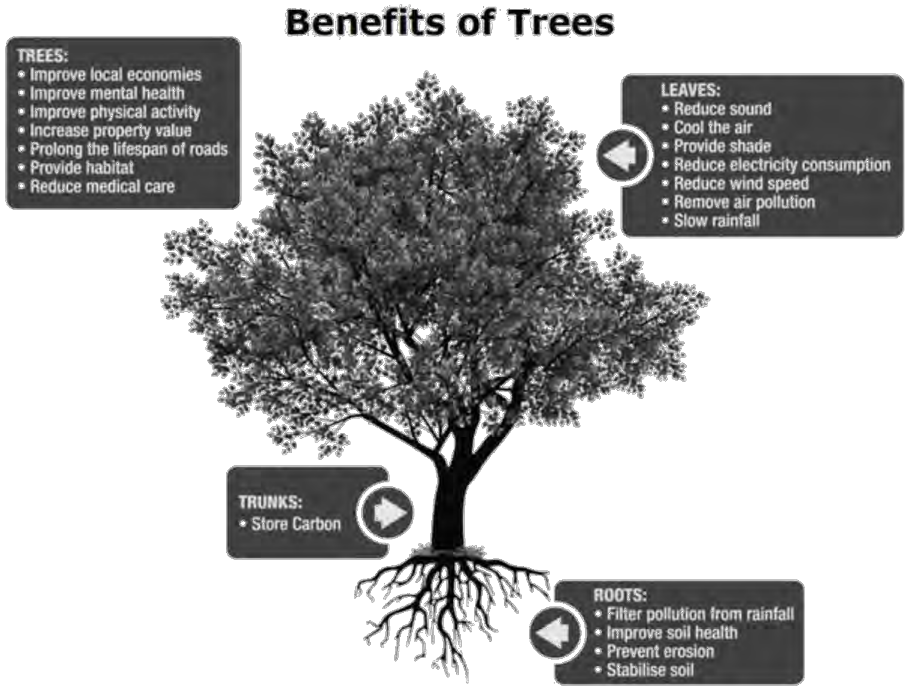
Contact with attractive, accessible green space or nature encourages greater levels of physical activity; can improve mood, and lower levels of stress, anxiety and depression.

The Moreland Urban Forest Strategy (UFS) aims to improve the health and liveability of the Moreland community through a diverse, resilient and robust urban forest. It will achieve this aim by nurturing a large urban forest that will perform well under future climate conditions and therefore maximise the benefits provided to the environment and the community.

Moreland City Council recognises the important contribution of vegetation, especially trees, in making the municipality a vibrant place to live, work and visit; and is committed to protecting, enhancing and managing our urban forest into the future. Many Moreland community members acknowledge the value and role of trees, in particular, their contribution to Moreland's character and sense of place.[ii]

Figure 1 illustrates some of the core services trees provide, including cooling the municipality on warm days, providing food and shelter for Moreland's wildlife, increasing property values, and easing stormwater flows into streets and waterways.

Figure 1. The benefits of trees



Combining sustainable water management with the urban forest amplifies the overall environmental, economic and social benefits. Water plays a crucial role in improving the quality of a space through greening, providing visually attractive blue space, and providing relief from high temperatures by cooling open space.

Investing in and maintaining the urban forest is a vital approach to urban management as it deals with the

challenges of population growth, resource constraints and community wellbeing.

Social and health benefits

There is a growing evidence base linking vegetation with significant health benefits as well as the lack of vegetation with poor social and health outcomes, including:

- Vegetation is a key component in facilitating a sense of place, community, neighbourhood character and social interaction; and
- Tree lined streets and parks can encourage physical activity[iii], reduced respiratory illness[iv], improve mental health and expedite recovery from medical care[v].

Additional research findings pertaining to health and wellbeing include:

- Adding 10 more trees per average city block has the effect of making residents feel seven years younger or $10,000 richer annually[vi];
- The same study found that having 11 more trees in a city block, on average, decreases cardio-metabolic conditions in ways comparable to an increase in annual personal income of $20,000 and moving to a neighbourhood with $20,000 higher median income or being 14 years younger;
- People living in areas with higher street tree density had a far better perception of their own health;
- Residents also reported fewer conditions of obesity and hypertension compared with residents living in areas with fewer trees; and
- The social and health benefits of more trees were observed for areas within a five-kilometre radius of the trees.

Trees are also related to positive safety outcomes. Built up areas with high levels of vegetation have been shown to experience approximately 50% lower crime levels than areas with low levels of vegetation and a 10% increase in the amount of tree cover has been associated with a 12% decrease in crime.[vii]

A child's mental and physical development is significantly improved when they have access to treed parks and reserves[viii], fostering a connection to nature and encouraging physical activity to combat the onset of health issues such as diabetes and obesity.[ix]

Pleasant parks and streetscapes can increase physical activity and promote active forms of transport. Moreland encourages walking and cycling within the municipality as physical activity is linked to improved health.

The urban forest further helps Council meet sustainable transport objectives as vegetated streets are known to calm traffic and thus reducing the risk to walkers and cyclists. Street trees also give motorists a defining edge to help guide their movements and to help them assess their speed, thereby increasing community safety.[x]

Rates of skin cancer are high in Australia. According to the Department of Health 1 in 2 Australians will develop some form of skin cancer in their lifetime. Tree canopies provide sun protection during summer months, filtering and blocking sun light to reduce ultraviolet exposure[xi] and assist in protection against skin cancer and heat stress. Heat stress is a growing concern under climate change with the 2009, 2014 and 2015 heatwaves resulting in 374, 90 and 174 respective deaths across Melbourne.

In 2014, Lucinda Coates and colleagues concluded that "the dangers from extreme heat within Australia remain neglected, and fundamental changes will not take place until extreme heat is given the priority it deserves as Australia's number one natural hazard killer."[xii]

Community planting days not only benefit the environment, but provide valuable opportunities for the community to meet one other, build a sense of place, celebrate their neighbourhood and connect with nature. Local friends groups together with Council run dozens of annual planting events to encourage community planting, biodiversity conservation and social connectivity.

Neighbourhood character

Landscape values provide a sense of human scale and soften the built landscape. Trees and vegetation can also reinforce the character of a neighbourhood and streetscape and visually link areas. Consistent planting themes within parks and streets can enhance landscape character. For example many parks and residential streetscapes within Moreland contain an eclectic combination of tree species. This Urban Forest Strategy provides guidance on some of the landscape values to consider including an assessment of the condition of the trees, a description of the planting site and a recommended planting approach for each park and street.

The urban forest can play a conservation role in cities from a heritage perspective. For example, several of Moreland's parks and streets include avenues of mature trees including Planes, Elms and Brush Box that were planted at a similar time to the establishment of the park or the construction of adjoining housing. These avenues add to the heritage character of the place and should be preserved. Unfortunately, many of these older plantings are starting to reach the end of their useful life with tree health declining due to maturity, water restrictions and climate extremes. Evidence of heritage tree decline has been observed in Temple Park, Methven Park and Fleming Park.

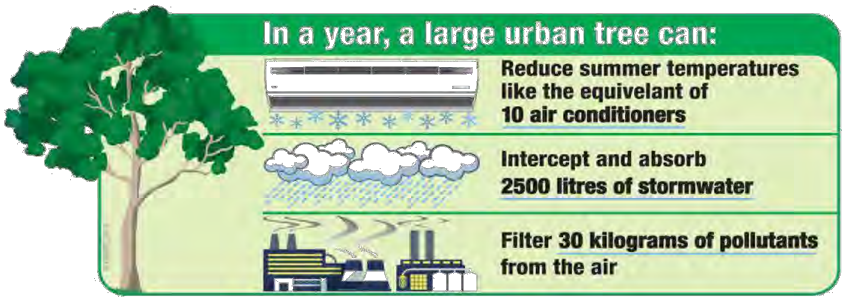
Moreland needs to start planning for the eventual replacement of these trees together with the local community to identify how to renew these landscapes whilst protecting the heritage character of the landscape. In some circumstances alternative plantings may be suitably and in others improved conditions will be required, such as improved soil structure (mulching, water availability and soil decompaction) and reduced conflict with infrastructure and services (See Reference Document 1).

Environmental benefits

The urban forest is an essential part of providing ecosystem services in urban areas. Urban trees for example filter particulate matter and pollutants from the air and stormwater, they reduce the flow and amount of stormwater by intercepting and storing rainfall and they improve groundwater flows[xiii] (Figures 1 & 2). Urban trees provide shelter, habitat and food for wildlife, and encouraging biodiversity.[xiv]

Trees are well known to intercept rainfall and reduce stormwater pressures. Mature deciduous trees, such as Liquidambars, intercept between 1.89 and 2.65kL of water per year, while evergreen trees including pines can intercept more than 15.41kL per year (Seitz & Escobedo 2011). Studies have also shown that urban runoff is much higher from asphalt (62%) than from surfaces with tree pits (20%) or turf (<1%) highlighting the effect that trees can have on stormwater reduction.[xv]

Figure 2. The environmental services provided by a large urban tree



Simple inexpensive interventions such as increasing soil and water volumes through the use of structural soils can amplify these benefits while improving tree health (See Reference Document 1). Additional studies show that simple structural soils are valuable in extending a tree's rooting zone below the pavement with no impact on adjoining road and building assets.[xvi]

There is growing recognition of the important role that urban environments can play in the conservation of biodiversity.[xvii] Before this, cities were historically excluded as a worldwide ecosystem type.

There is also the intrinsic value of nature to consider. Trees can be incredibly magnificent in their own right and provide a critical connection to nature in our increasingly urban lives.

The urban heat island effect

When looking at the cumulative effects of the urban forest, it has the capacity to significantly reduce the urban heat island effect as well as providing relief during heatwaves[xviii] by shading people, buildings and infrastructure, and cooling the local environment, lowering the impacts of localised heat retention and re-radiation.

The urban heat island (UHI) effect is one of the most significant issues affecting urban environments in relation to current and future climates. UHI relates to significantly warmer temperatures experienced in

metropolitan areas in comparison to surrounding rural areas.

The main cause of the urban heat island is the modification of the land surface with vegetation removal and through urban development, which uses materials that effectively retain heat. The UHI can also decrease air quality by increasing the production of pollutants such as ozone, and decrease water quality through the cycling of warmer water into catchments, which can affect vulnerable ecosystems.

Mitigation of the urban heat island effect can be accomplished by reducing urban albedo (i.e. reflective and absorbing hard surfaces), and the most efficient method to reduce urban albedo is by the placement of trees around structures to lower surface and air temperatures by providing shade and evapotranspiration.

Just a 10% increase in vegetation cover has been shown to reduce average air temperatures by 2.5° Celsius during a heatwave. This is a critical finding because heatwaves result in mortality and morbidity spikes in Melbourne. During the extreme heatwave and Black Saturday fires of 2009, 173 deaths were a direct result of the fires. However, what is less well known is that 374 people died from the heatwave. During the extreme heatwave of 2015, 174 people died in the Melbourne metropolitan area.
Evapotranspiration, alone or in combination with shading, can help reduce peak summer air temperatures by 1–5°C. Surfaces shaded by trees can commonly be 11–25°C cooler than the peak temperatures of unshaded materials; however on days of extreme heat the temperature difference under a tree canopy can be more than 30°C lower that unshaded areas. Reducing air and surface temperatures during heatwaves will be critical for reducing ambulance call outs and mortality and morbidity rates from heat stress amongst Moreland resident.

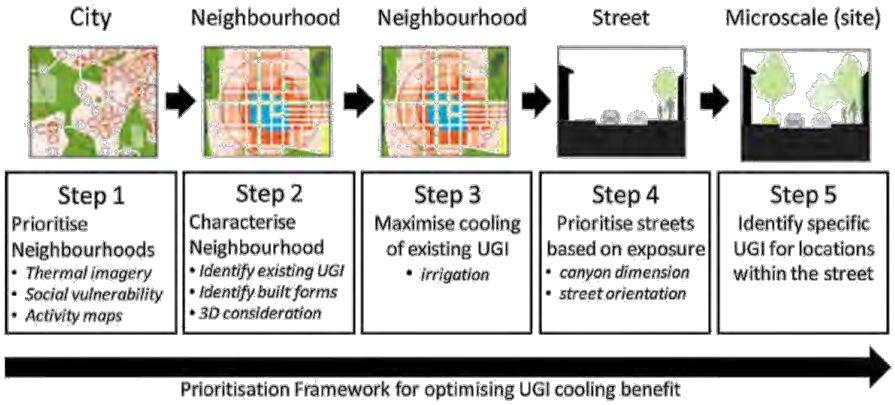
Vegetation and cooling

A strong evidence base supports the cooling benefits of increasing vegetation cover, including:

- **Key factors influence the cooling effectiveness of Moreland's urban forest:**
  - Location
  - Size and canopy coverage
  - Planting density
  - Irrigation management.[xix]
- **Maximise the cooling benefits of existing vegetation**
  - Irrigation is critical for realising the cooling benefits of grass and trees during the day.
  - Passive irrigation can improve vegetation health, however increasing stormwater and wastewater capture and storage for irrigation use during extreme heat periods is a priority[xx]
  - Moreland should therefore consider enhancing the delivery of services from existing vegetation and open space by improving vegetation health through water sensitive urban design (WSUD). This will require an analysis of Moreland's stormwater systems data, blockage and flooding data, surface permeability data and surplus stormwater resources.
- **More vegetation and trees are required**
  - Irrigation is an effective mechanism for cooling day time temperatures.[xxi] Council is reviewing current irrigation practices of open spaces and street trees as part of the Urban Heat Island Effect Action Plan.
  - Gaps need to be identified within the existing coverage of vegetation and open spaces and related to temperature 'hot spots', social vulnerability and core activity centres.
- **Some plant characteristics are more effective than others**
  - Broadleaf vegetation provides the best canopy shade and cooling benefits.
  - Canopy variation may improve night-time cooling through species diversity or formative pruning.
  - We know little about the cooling performance of different tree species under different irrigation regimes.
- **The location of trees is critical to maximise cooling benefits**
  - Appropriate selection and placement of tree species is important to maximise the delivery of their cooling benefits arising from both the provision of shade and evapotranspiration. An analysis of

existing hot spots, social vulnerability and activity zones in Moreland is an essential first step (Figure 3).

Figure 3. Priority steps for achieving cooling benefits from the implementation of an urban forestry (Urban Green Infrastructure, UGI) programxxii



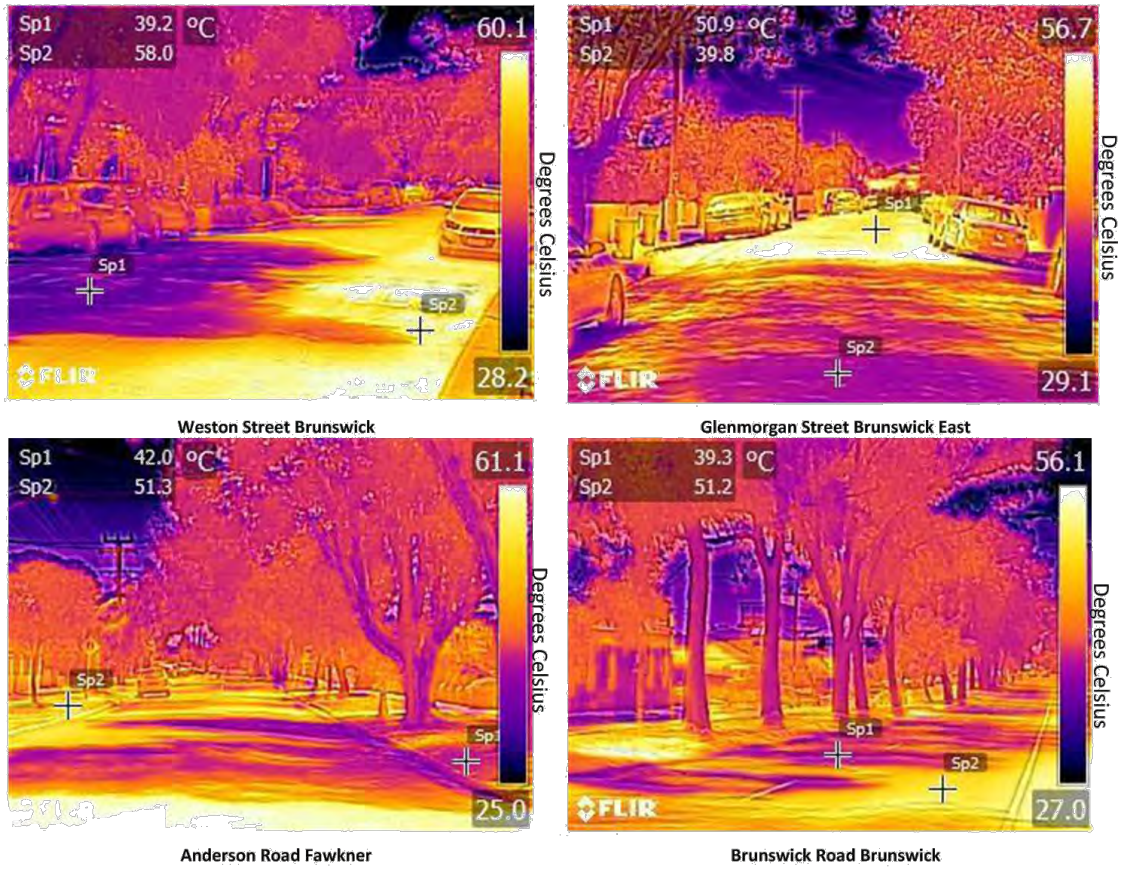
Options for street trees, open spaces, green walls and green roofs will depend upon the characteristic of each site and are discussed below.

- *Street trees*
  - Priority shading of building and paved surfaces in particular on footpaths, cycling paths and west facing buildings around activity centres, such as retail strips, schools, health centres, transport hubs (Norton *et al.* 2015).
  - Street trees in urban canyons provide the largest cooling benefits. The term urban canyon is useful for describing Moreland's streets because most streets are characterised by a wide open street (floor) enclosed by buildings (walls) on either side.[xxiii] Street orientation together with the width of the street and the height of adjoining buildings are important considerations for determining where and what type of vegetation to grow.
- *Open space*
  - Prioritise the creation of open space in areas upwind of hot spots with high heat exposure, particularly in areas with vulnerable populations.[xxiv]
  - In dense urban areas such as Moreland, the creation of small pocket parks can still benefit neighbourhoods.[xxv]
  - Irrigate grass and trees during extreme heat periods to maximise day time cooling benefits
- *Green walls*
  - In narrow streets (urban canyons) or where there is a high concentration of above ground utilities (ie powerlines) then irrigated street level vegetation and green walls (with air cavity) are an effective cooling option.[xxvi]
  - An alternative option is undergrounding or aerial bundling of cables (ABC) of powerlines to improve canopy cover and reduce maintenance costs.
  - Consideration: in areas where vertical vegetation is not viable then building awnings and overhangs should be considered.
- *Green roofs*
  - Irrigated green roofs provide some benefit particularly in reducing rooftop surface temperatures and minor microclimate benefits on low buildings. The cooling benefits of unirrigated green roofs are minimal.

The following images (Figure 4) clearly illustrate the critical role of vegetation in moderating the extreme temperatures observed in Moreland streets using ground based thermal imaging. The images clearly highlight the benefits of shade provided by tree canopy on cars, road surfaces and buildings. The thermal images were shot on a 41°C day and show that vegetation can moderate temperatures by up to 35°C.

Trees shade both people and hard infrastructure such as roads and buildings from direct sun and UV rays during summer. This has the significant positive impact of reducing energy use in buildings by lowering mechanical cooling requirements and therefore avoiding further carbon emissions.[xxvii] This shading also protects and prolongs the life of asphalt paths and roads[xxviii], reducing maintenance costs, and extending their longevity and need for replacement.

Figure 4. Ground based thermal images of Moreland streetscapes, Celsius



Weston Street Brunswick

Glenmorgan Street Brunswick East

Anderson Road Fawkner

Brunswick Road Brunswick

Economic benefits

Trees shade both people and hard infrastructure such as roads and buildings from direct sun and UV rays during summer. This has the significant positive impact of reducing energy use in buildings by lowering mechanical cooling requirements and therefore avoiding further carbon emissions.[xxix] This shading also protects and prolongs the life of asphalt paths and roads.[xxx] It has also been proven that trees enhance residential property values while reduce the time the property is on the market.[xxxi] Treed streetscapes have been shown to increase adjoining property values by an average of 20-30%.[xxxii]

Trees in retail streetscapes also improve retail and commercial area patronage by enticing people to stay longer and spend more.

Consumers will sometimes spend an additional 9% on an item in retail developments that include street trees

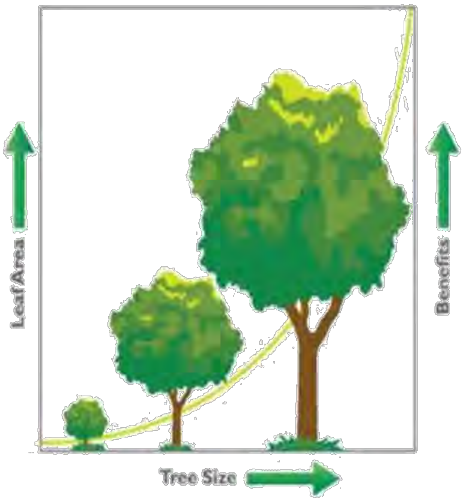
compared with the same item in a non-treescaped retail outlet.[xxxiii] Another study revealed that street trees can increase business income by 20%.[xxxiv]

Through the use of an urban forest modelling tool called i-TreeEco, we can now attribute dollar values and weight measurements to most environmental benefits of trees. Air pollution amelioration, stormwater capture, carbon stored and sequestered can all be measured in quantities and dollars to allow much more accurate cost benefit analyses of trees.

These benefits clearly demonstrate the idea that urban trees are valuable contributors to civic infrastructure, or sometimes referred to as green or living infrastructure. It is also evident that larger trees provide greater social, environmental and economic benefits (Figure 5).

The utilisation of larger tree species will maximise the environmental, social and economic benefits provided by trees and facilitate sustained benefits for generations to come. Larger trees sequester more carbon, abate more pollution, provide greater reduction in urban heat and increase property values. Trees that live longer sequestered carbon for longer, remove more pollutants and avoid losses caused by cyclic tree removal. To facilitate optimised tree selection and planting, an improved tree planting program and design principles have been developed and should be implemented.

Figure 5. Relationship between a tree's leaf area, tree size and the social, economic and environmental benefits



4. MORELAND'S URBAN FOREST

As of 2017, Moreland City Council currently manages over 130,000 trees in our parks and streets (2017). The health of the forest is good with a majority of trees yet to reach maturity, but there has been an over reliance on small trees and a high mortality rate of newly planted trees.

In 2016, Moreland City Council's Open Space units undertook the following urban forest works:

- Pruned over 30,000 trees
- Completed 4,000 tree inspections
- Planted 5,000 street trees
- Allocated $1 million to the annual planting and maintaining its urban forest
- Supported 16 community planting activities
- Managed weeds in over 1,500km of kerbside
- Responded to around 6,000 customer requests
- Maintained over 83 hectares of natural revegetation sites;
- Mowed over 7,500 Hectares of parkland
- Managed over 200 hectares of conservation land
- Undertook over 1,100 ground maintenance visits to childcare centres

During the past decade, Moreland City Council has planted over 40,000 trees through a range of programs including: the in-fill planting program, park renewals, streetscape improvements program, and annual capital works projects. In addition, Moreland City Council is responsible for protecting and restoring our sensitive creek environs. Through a range of programs and community events, the revegetation area has grown by 39,000m^2 over the past decade. As a result of this work, tree canopy cover from street trees and park trees has grown by 26% and 63% respectively from 2005 to 2016.

The single largest greening project for Council has been the annual street tree planting program which was developed based on the following criteria:

- Identified vacant tree sites (the in-fill program);
- Resident requests – where a street is either missing a number of trees or its trees are in poor health and need of replacement;
- Replacement trees for street and park tree removals; and
- Internal Council projects.

Moreland's annual street tree program has grown from planting 2,769 trees annually in 2006, to 3,548 in 2010, and 5,000 in 2016.

However, the combination of a 5% annual senescence for the overall forest and an average 20% failure rate for newly planted trees has meant that the net increase in trees from these programs since 2006 was only 12,054 trees. The reasons for the high failure rate are varied and complex, but clearly demonstrate that implementing the urban forest strategy requires a significant improvement in the average annual establishment rate of new plantings.

In short, once Council has filled the existing vacant sites, it could be planting half as many trees but focusing on larger canopy trees and improved tree health to ensure overall net gain. For this to occur, significant improvements in tree selection, planting and establishment practices are recommended combined with improved management and community engagement.

Details of these improvements are provided in the technical document section of the Appendices.

Street Tree Audit

A sample tree audit of 14,000 trees was undertaken to collect data on the various aspects of each tree: health, age, species and life expectancy.

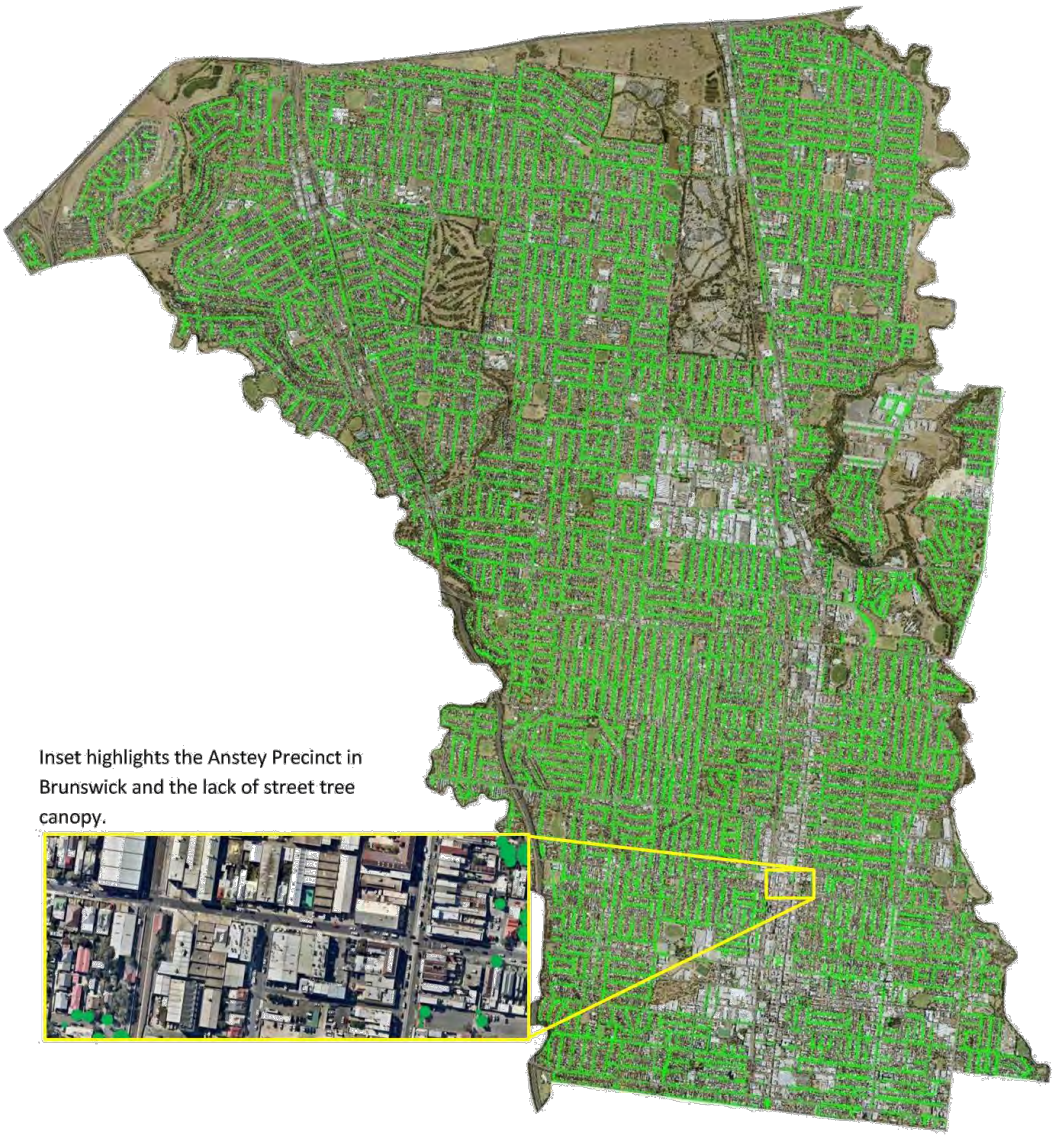
Little is known about Moreland's private trees such as those on resident's properties. The difficulty of accessing private property to survey trees and limitations in aerial imagery makes it difficult to understand the diversity, overall health and number of private trees. However, their contribution to the urban forest is of equal important.

The technical analysis of Moreland's urban forest is presented in full in Part Two with some of the key observations of pertinence for the Urban Forest Strategy summarised below.

An overview of all street trees currently within Moreland City Council is provided in Figure 6 with an example of an area highlighted. This area around Anstey Railway

Station in Brunswick highlights the significant lack of street tree canopy present in a busy retail, transport and residential activity centre and also priority hot spot location. Despite the high pedestrian needs in the area, the lack of building setbacks and narrow footpaths will make planting street trees challenging without a re-imagining of the streetscape. A design response as part of a capital works project is most likely required (see Street Tree Planting Plan).

Figure 6. Current Moreland street tree locations map with Anstey precinct inset



12

Urban forest management

Key findings of a review of Moreland's urban forest produced the following findings:

- In 2017, Moreland has over 59,000 street trees and around 70,000 park trees
- A long term strategic approach to tree planting would better enable council to improve tree canopy, streetscape amenity and general tree health across the municipality.
- An improvement in the quality of planting and establishment practices are required to improve tree survival and health.
- Significant challenges remain in reversing the incremental and diffuse loss of vegetation and trees from Moreland's public and private landscapes. With the exception of several key parks and the waterways revegetation programs, most Council landscapes are serviced at basic levels. Maintenance activities are largely limited to mowing, pruning and herbicide application with little or no resourcing of renewal planting. If not remediated then the outcome will be a decline in the presentation of the municipality as well as a reduction in the delivery of economic, environmental and social ecosystem services from Moreland's urban forest.
- Challenges remain in ensuring greening is part of the transformation of Moreland's three activity centres (Brunswick, Coburg and Glenroy) to ensure that opportunities are made available for street trees and integrated into the rationalisation and improvement of existing roads, transport and services infrastructure. The integration of vegetation within Moreland's activity centres is critical for softening the dominant hard edged built form in line with best practice urban design principles to produce a high quality public realm.
- Some community and resident planting projects in nature strips, parks, car parks and along railway corridors are regularly sprayed out with herbicide or slashed. Such actions undermine community confidence in Council's commitment to encourage resident greening activities.
- Community and resident groups find it difficult to understand Council policy and decision making processes in regard to tree planting, tree removals, community gardens
- A limited understanding tree risks across Council and the community and needs to be managed appropriately in line with best practices and the evidence base.

Tree health

- 95% of the current tree population assessed to have good canopy health
- 57% of the current street tree population is comprised of trees less than 5 metres in height. The majority of these trees will not attain canopy dimensions that will significantly contribute to the amenity and environmental benefits in their streetscapes.
- 71% of street trees are expected to live for more than 30 years
- 3% of street trees estimated to have life expectancy less than 10 years

Benefits

- All of Moreland's street trees have a combined amenity value of over $270 million
- Moreland's street trees store over 11 tonnes of carbon dioxide (CO_2) and remove a further 912 tonnes annually.
- The current environmental and amenity value/risk of an over reliance on the Family Myrtaceae: $179,441,036
- An over reliance on small, short-lived trees limits the potential canopy and benefits of the urban forest.

Species diversity

- 66% of tree species are from Myrtaceae Family
- Callistemons make up 26% of street trees
- Callistemon and Eucalyptus represent 46% of the current street tree population
- 86% of tree species are from 20 Genera
- 94% of trees are less than 10 metres in height
- The low species diversity of Moreland's urban forest makes it susceptibility to the widespread effects of current and introduced pests and

disease, and the risk of large scale loss of these environmental assets from climatic extremes.

This Strategy details improved management approaches to transform Moreland's urban forest from its current state to become more coordinated, sustainable and attractive. This requires a dramatic shift away from the current approach to tree planting and the adoption of a high level of interdependence between management planning for existing trees, the application of life cycle planning principles to the management of the tree population and adequate resourcing.

Over the next decade, Moreland's residents are likely to demand greater amenity improvements to our parks and streetscapes. At the same time, Council has an obligation to improve the health and wellbeing outcomes for the whole community. It is therefore important that Council acknowledge and endorse the following as a priority:

- Implement, and resource, the recommendations and action plan of this Strategy;
- Protect and maintain existing trees;
- Continue to invest in improving the quality and coverage of trees in the public realm; and
- Explore new opportunities for the provision of trees and vegetation across Moreland.

5. DIVERSITY

Moreland's streets are currently populated with an estimated 58,113 trees, which consist of a diverse mix of exotics (26%), natives (69%) and indigenous native (4%) vegetation.

The following list of tree species includes those identified to be indigenous to Moreland and that are suitable as street trees.

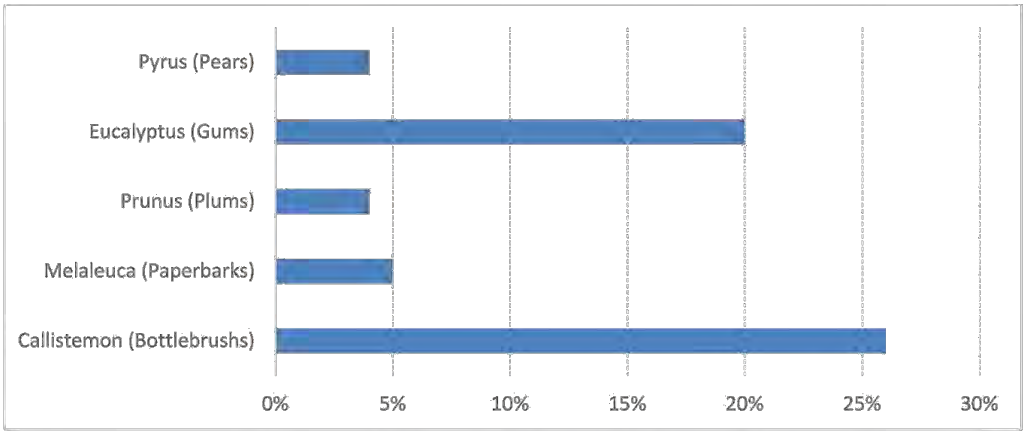
Acacia implexa Lightwood
Acacia melanoxylon Blackwood
Allocasuarina littoralis Black She-oak
Allocasuarina verticillata Drooping Sheoak
Eucalyptus camaldulensis River Red Gum
Eucalyptus melliodora Yellow Box
Eucalyptus polyanthemos Red Box
Eucalyptus tricarpa Red Ironbark
Eucalyptus viminalis Manna Gum

There are more than forty (40) different plant families represented within the current street tree population, but currently twenty genera represent 86% of all street trees. Approximately 394 different tree species are identified within the Moreland City Council Street Tree Inventory data, with no species representing more than 10% of the total population.

Figure 7 highlights that Moreland City Council has had a strong priority of enhancing the native component of its streets, which is reflected by its most common street trees, *Callistemon* (25%) and *Eucalyptus* (20%). Such an emphasis has been focused on a small number of Genus and Species and requires a broader diversity of species to manage the potential significance of pest and disease considerations.

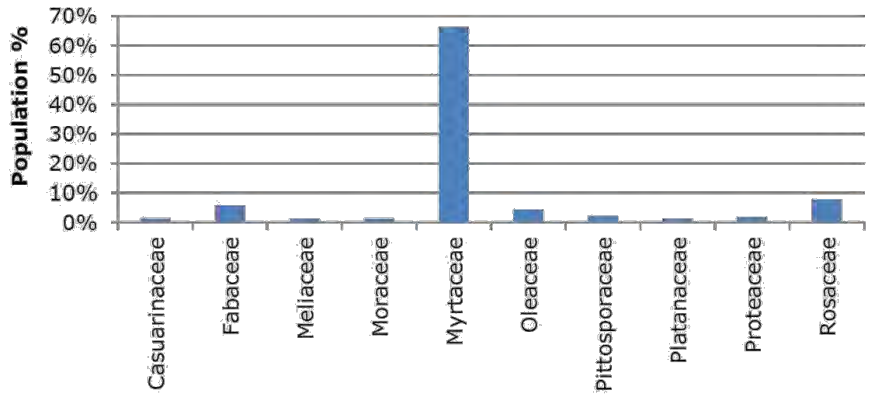
The most common species is *Callistemon viminalis* at just under 10% of the population ...

Figure 7. Tree diversity: most common street tree genera in Moreland



There are more than forty (40) different plant families represented within the current street tree population; however Figure 8 highlights that there is a preference for native species with 66% of all species from the family Myrtaceae. The dominance of Myrtaceae poses a risk for Council in terms of diversity and is to be addressed as part of future plantings.

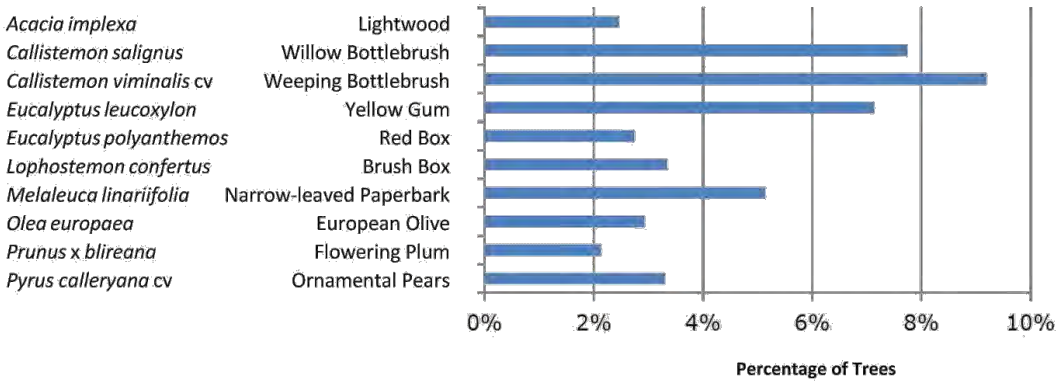
Figure 8. Tree diversity: Most common street tree families in Moreland



The Myrtaceae family includes species from genera: *Agonis*, *Angophora*, *Callistemon*, *Corymbia*, *Eucalyptus*, *Lophostemon*, *Syzygium* and *Tristaniopsis*. Most of these species are native to Australia, and have likely been selected for their hardiness and adaptability, as well as their aesthetic character.

Figure 9 shows the ten most common species within Moreland City Council streets and highlights the dominance of the *Callistemon salignus, C. viminalis, Eucalyptus leucoxylon* and *Melaleuca linarifolia*.

Figure 9. Tree diversity: Most common street tree species in Moreland



Diversification is a basic rule for reducing risk when managing financial assets. A similar approach is helpful in managing our urban trees because a greater diversity of species and ages ensures greater resilience and stability of the urban forest.

To minimise the potential for tree loss through issues of pest, disease, drought, heat, flood etc. diversity within the urban forest is paramount to its survival, longevity and succession. It is generally accepted that the greater the diversity, the lower the risk. Street tree and biological diversity can be achieved through species selection, stock provenance, maturity, and rates of growth.

Commonly used diversity benchmarks, introduced by Santamour[xxxv], are:

- Plant no more than 30% of a family
- Plant no more than 20% of a genus
- Plant no more than 10% of a species

These benchmarks are not scientifically validated within urban environments, but they provide a conservative guide to ensure diversification within a forest setting so as to minimise the potential for widespread loss in the event of environmental extremes and plant pathogen incursion.

Moreland City Council will use these benchmarks as a guide to modify species selection for the future street tree population.

Native street tree plantings were predominantly comprised of Myrtaceae tree species; and approximately 4% of current street trees are indigenous to the area.

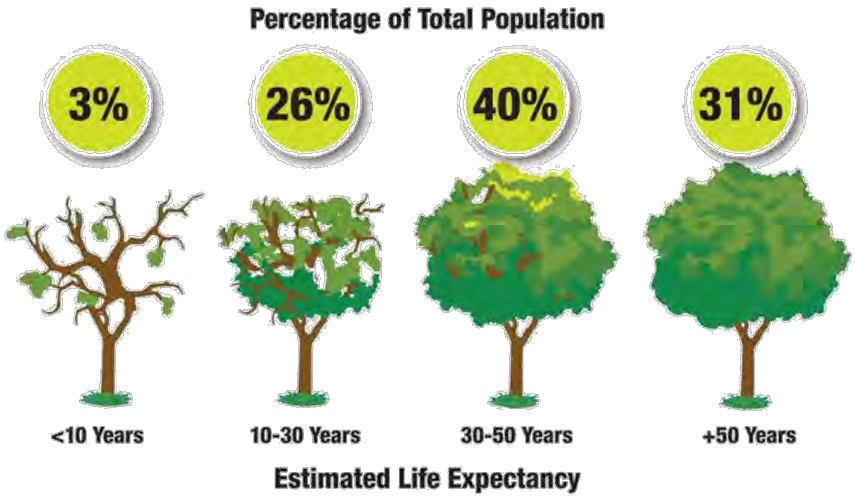
Species within the Family Myrtaceae are generally acknowledged to have high environmental adaptability, low pest and disease susceptibility and are particularly adapted to local climatic variance. While Council should acknowledge that greater Family diversity should be encouraged in a gradual shift away from Myrtaceae. However, a rapid move away from Myrtaceae species will likely have greater impacts on the economic, amenity, and environmental benefits of the urban forest and its resilience to current and future environmental and climatic conditions.

Useful Life Expectancy

Approximately 3% of the street tree population have an estimated life expectancy of less than 10 years. Life expectancy was assessed based upon the species, maturity (i.e. stage in life cycle) and current health of each sampled street tree. These assessments were then extrapolated for the entire population. The low abundance of dying trees (<10 years life expectancy) reflects an active management program that is removing dead and severely declining trees, and the greater abundance of tees with a life expectancy of over 30 years indicates an active program of tree replacement, and infill of vacant plantings.

Figure 10 provides a summary of the estimated life expectancies of Moreland City Council street trees.

Figure 10. The estimated life expectancy of Moreland's urban forest



Tree Height and Canopy

Currently 57% of all trees are less than 5m in height due to two factors. Primarily, an over reliance on small tree species, such as Callistemon, Prunus and Malus trees even on sites without powerlines. This shift to small trees was a strategic decision of the Open Space Unit in order to assist in maintaining trees and reducing complaints arising from conflict with other assets (powerlines, signage, vehicles etc.), tree root damage to buildings and fences, overhanging limbs and storm damage. A secondary cause of the small tree size is a result of poor tree establishment and maintenance practices that result in underperforming trees.

The dominance of smaller trees constrains potential canopy cover across the municipality as most of these trees have a canopy width of less than four metres.

Health

A healthy urban forest is central to the health and wellbeing of Moreland's community. Key ingredients for a healthy urban forest include soil health, water availability, free of pest and diseases, a healthy form and canopy, and an even age distribution of the forest.

A 2016 assessment of Moreland's street trees found that 95% were in either excellent or good health. Figure 11 provides a summary of the estimated health of the urban forest. This summary shows that more than 95% of the current street tree population display leaf size, colour, density and internodal (seasonal) growth typical for their species. These are generally regarded as key indicators of good health. The low population of "Critical" and "Dying" trees reflects an active tree management program that removes these specimens so as to mitigate risk and maintain streetscape amenity.

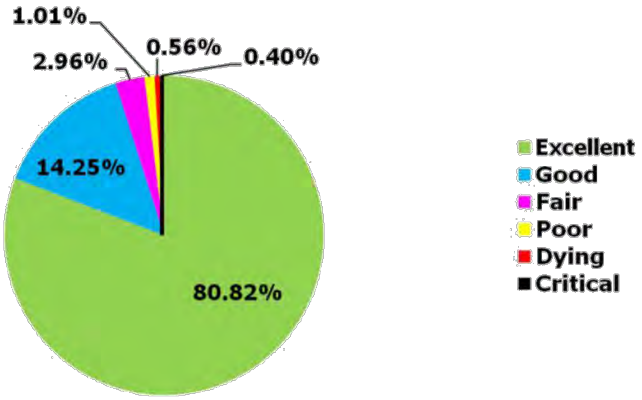


Figure 11. Summary of the estimated health of Moreland's urban forest

Moreland has several significant treed avenue streetscapes that transform neighbourhood character

6. CANOPY COVER

Canopy cover is an important part of the urban forest strategy. It can be used as a proxy for measuring the extent of the urban forest. Canopy cover is a measure of the physical coverage of the combined tree canopy cover over the land area. Moreland's 14% canopy cover means that 14% of the 50.9km2 land area of Moreland has tree canopy. Measuring the change over time and location and composition of this canopy help Council and the community understand where we are performing well and areas that may need interventions.

Council have undertaken a successful street tree planting program that has increased canopy cover from park and street trees three fold since 1989. However, the private realm is the largest contributor to tree canopy across Moreland (Figure 12). Urban consolidation over the past decade has resulted in a steady decline in vegetation within the private realm. As a result, the burden for providing future tree canopy in Moreland is increasingly shifting to the public realm and Council. There is an increasing reliance on council parks and road reserves for canopy cover and green space as dwelling construction removes existing trees and limits future tree planting opportunities.

A 2016 detailed canopy cover analysis (Figure 12) found:

- Tree canopy cover across Moreland was 14%
- Overall tree canopy cover initially grew from 1989 through to 2005 but has since declined due to urban consolidation.
- Street tree canopy and park tree canopy contribute just 2.4% and 2.6% of Moreland's land cover respectively.
- Despite the strong medical and scientific evidence base about the benefits of trees, in 2017 approximately 85% of Moreland's streets are without any natural shade
- Between 1989 and 2016:
  - Park tree canopy has grown 257%
  - Street tree canopy has increased 300%
  - Private tree canopy has declined 28% from 12.7% to 9.2%
  - The footprint of buildings has grown 15% from 26% to 30%
- Urban consolidation is the main cause of declining canopy cover in the private realm since 2010. A reduction in canopy cover in streetscapes has been caused by: the Tulla Freeway widening; new development cross overs; and, powerline pruning and clearance programs.
- Canopy cover from street trees varies across Moreland's suburbs from 4.5% in Gowanbrae to less than 1% in Hadfield and Oak Park.
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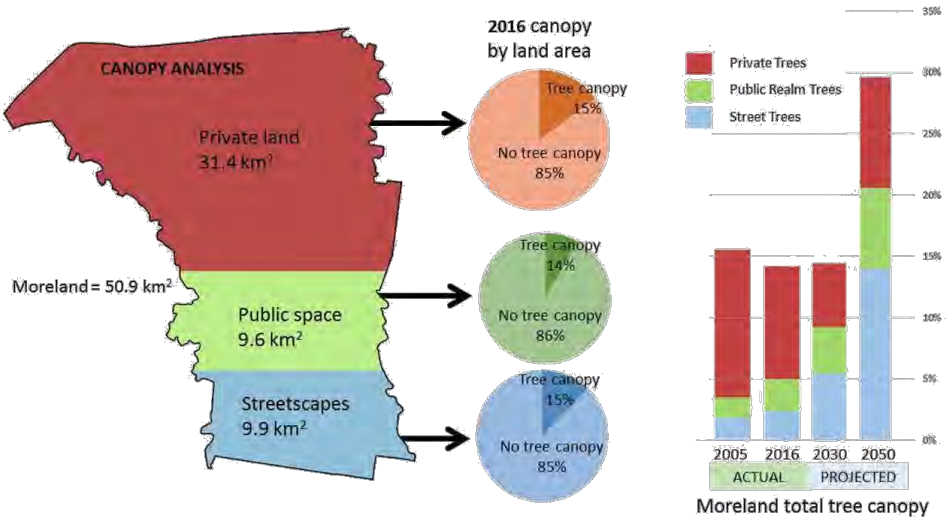


Figure 12. Moreland tree canopy by land area, 2005-2050

Over the coming decades, population growth and urban consolidation are likely to continue delivering larger building footprints and reduced opportunities for the planting of trees in shrinking private backyards. However, the public realm is likely to be equally constrained with increased demand for pedestrian movement, parking and traffic combined with reduced light availability and physical space for tree canopy due to higher density, taller buildings.

Moreland's 14% canopy cover compares with 17.3% tree canopy cover in Darebin and 18.5% in Yarra. In contrast, Wyndham in Melbourne's west has 3.1% cover but 80% grass cover while Manningham in Melbourne west has 40% canopy cover (Figure 13). Critically, the canopy analysis has identified significant scope for increasing canopy cover across Moreland's public and private realm.

The evidence base on canopy cover and change over time reveals a need for a strategic response by Council and the community if we are to realise the vision of transforming Moreland into a municipality where healthy trees and vegetation are a core part of the urban environment.

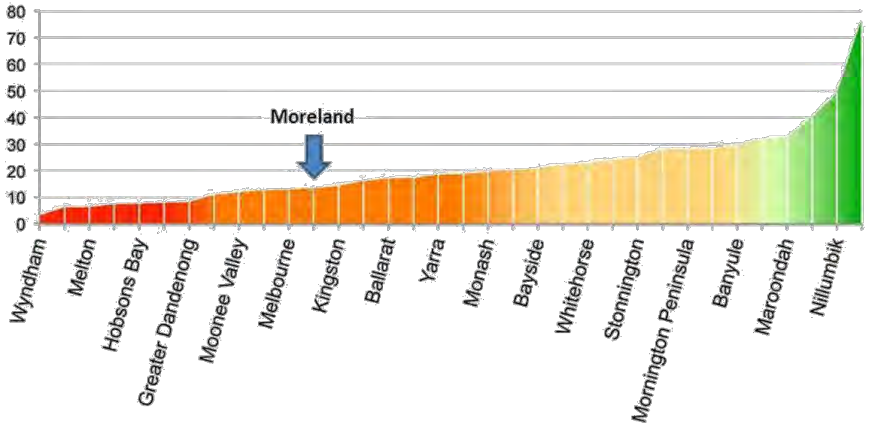


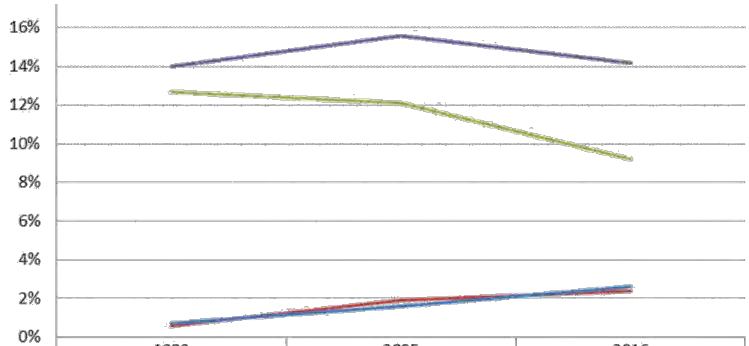
Figure 13. Canopy cover (%) for selected Victorian Local Government Areas[xxxvi]

The distribution of tree canopy cover

Moreland's 130,000 trees are fairly evenly distributed across the municipality. However, the age and size of these trees varies significantly and as a result the canopy cover provided by these trees also varies accordingly. Canopy cover is often used as a proxy for measuring the contribution of trees and vegetation to urban greening.

In this report, canopy cover measures the physical coverage of tree canopy over the land.

Currently within Moreland City Council, trees are providing 14% canopy cover (Figure 14). These statistics roughly align with the study conducted by the Institute of Sustainable Futures[xxxvii], which benchmarked Moreland City Council with 13.3% tree canopy cover in 2014.



	1989	2005	2016
Total canopy cover	14.0%	15.6%	14.2%
Trees on private property	12.7%	12.1%	9.2%
Street trees	0.6%	1.9%	2.4%
Park trees	0.7%	1.6%	2.6%

Figure 14. Change in tree canopy types as a proportion of Moreland land area, 1989, 2005 & 2016

During the past decade, overall canopy cover has declined from 15.6% to 14.2%. Urban consolidation is the main cause of the decline in private realm canopy from 12% to 9%. During the same period, canopy cover from street trees and park trees has grown by 26% and 63% respectively. Despite the strong medical and scientific evidence base about the benefits of trees, approximately 85% of Moreland's streets are without any natural shade.

Canopy cover was measured over two different years to understand change over time in the public and private realm.

The canopy cover figures for Moreland's streets were based upon three different methods: a land use assessment of 8 suburbs, a land cover assessment of all Moreland and a canopy analysis using iTree Canopy. iTree Canopy is a web-based software tool designed to easily and accurately estimate tree and other land cover classes (e.g., grass, building, roads, etc.) within a city or area. Details of the iTree Canopy assessment are provided in Reference Document 1.

In addition, the iTree Eco stratified sample provided canopy cover estimates for each tree assessed. This analysis was then used to extrapolate the estimated canopy cover within each suburb, and for the entire street tree population. This data was then compared with the results from the iTree Canopy tool and more comprehensive canopy mapping analysis undertaken by Greenspace Consultant.

Table 1 provides a summary of the street tree canopy cover estimates for each suburb. The suburbs of Gowanbrae, Glenroy, Hadfield, Oak Park and Coburg all have a higher number of street trees per area of the suburb and yet this does not necessary equate to canopy cover. There are numerous constraints which limit the location and size of street trees, and therefore tree canopy, including for example, the availability of nature strips, the width of footpaths (where most trees have traditionally been planted), the setback of buildings, overhead powerlines and street lights.

.

Table 1. Current street tree population and contribution to canopy cover by suburb

Suburbs	Area of suburb km²	2016 street trees (prior to 2016 planting season)	Street tree canopy as % of suburb
Brunswick	5.2	6,034	1.7%
Brunswick East, Fitzroy North	2.3	2,930	2.1%
Brunswick West	3.2	4,260	1.6%
Coburg	7	9,525	2.5%
Coburg North	4.9	3,823	1.6%
Fawkner	5.1	5,910	1.4%
Glenroy	9.1	7,203	4.1%

22

Gowanbrae & Tullamarine	1.4	643	4.5%
Hadfield	3	2,594	0.7%
Oak Park	1.9	1,629	0.8%
Pascoe Vale	4.9	5,618	3.8%
Pascoe Vale South	3	4,044	2.3%
Moreland Council Total	**50.9**	**54,313**	**2.4%**

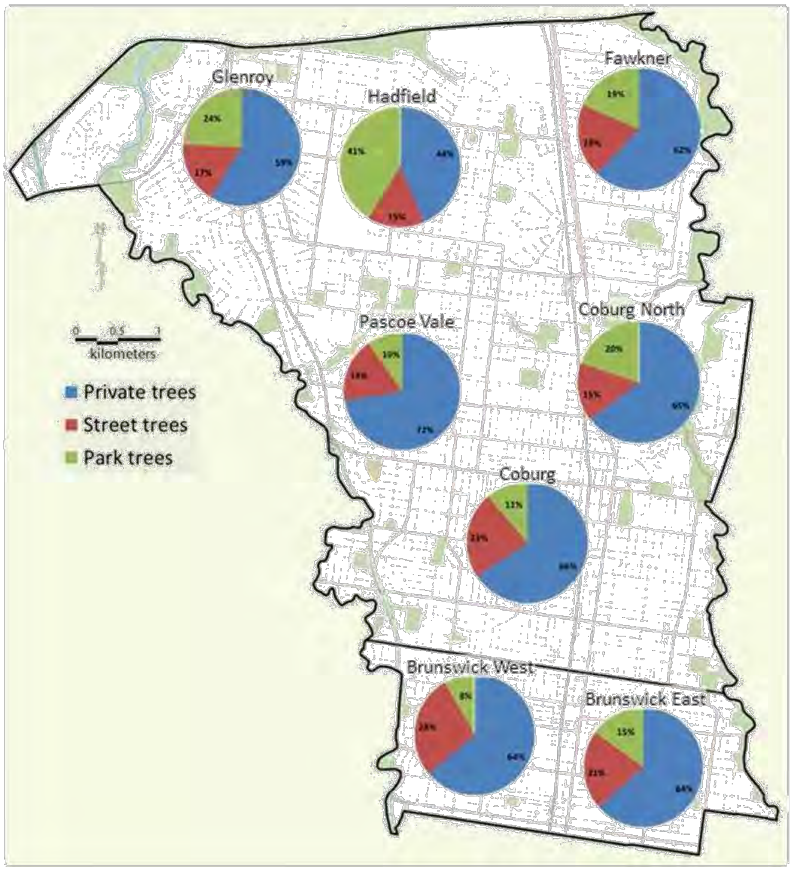


Figure 15. 2016 Suburb tree canopy cover proportions by street, park and private land, percentage

Figure 15 clearly illustrates why Moreland's overall tree canopy cover has declined during the past decade despite the significant growth in public realm tree canopy (albeit from a low base). A comparative analysis was conducted on three sets of aerial photography: 1989, 2005 and 2016 (Figures 15). Over time there has been an increase in hardscapes and a reduction in trees on private property. The land use change assessment also identified opportunities for planting trees in both the public and private realm.

Figure 15 provides a breakdown of the tree canopy variation between different Moreland suburbs in regard to the contribution of park trees, street trees and private trees. The proportion of street trees is generally consistent across the municipality at around 20% and is representative of the presence of roads. Private trees dominate the canopy of all suburbs except for Hadfield due to the large area of the cemetery. The contribution of park trees to canopy generally represents the area of open space in each area. For example, the large green

space areas taken up by Glenroy's golf course and Hadfield's cemetery raise the contribution of park trees. In contrast, Brunswick West, Coburg and Pascoe Vale have fewer parks and therefore park trees only contribute around 10% of total canopy

The trees managed by Moreland City Council contribute to the character and identity of our neighbourhoods. The combined total of canopy trees on Council land has grown from a low base of 1.3% in 1989 to 5% in 2016, which reflects Moreland City Council's increased and ongoing program of tree infill and replacement planting. During the same period, canopy cover from trees in the private realm has declined by 28%.

Kaspar examined the issue of Moreland's tree canopy cover in more detail by assessing canopy cover, change over time and the reason for this change.[xxxviii] Kaspar found that tree canopy cover in Pascoe Vale had declined from 18% to 15.6% between 2010 and 2015. The cause for this change was largely due to a 19% decline in private realm tree canopy or 160,625m^2 of tree loss. Urban consolidation was the main driver of this decline. This decline was equivalent to the loss of 345 netball courts of tree canopy in Pascoe Vale. The decline in private canopy was exacerbated by a 10% decline in street tree canopy. The removal of street trees to facilitate vehicle cross overs (Figure 69) was the main driver for this loss together with dead tree removal and pruning works.

On a more positive note, between 2010 and 2015 total tree canopy increased in Brunswick East by nearly 16%. This was largely due to tree canopy growth in the private realm (12.5%) and also from street trees (23.6%) and park trees (15.8%). Private realm trees make up the largest proportion of canopy in Brunswick East (Figure 15). Street tree canopy made up around 20.7% of streetscapes in Brunswick East, 17% in Coburg and 15.4% in Pascoe Vale.

Rather than assess tree canopy as a proportion of the total land area, Kaspar examined tree canopy within different land use types. For example, street tree canopy as a percentage of the area of Moreland's streetscapes or road reserve (road, footpath and nature strip). This is a similar measure to how the City of Melbourne assesses tree canopy figures. When the City of Melbourne note they currently have 20% tree canopy, this figure relates to the proportion of tree canopy relative to the area of public realm.

Figure 16 provides a detailed overview of the percentage change in canopy cover between 2011 and 2016, which was a period of significant urban consolidation across various parts of Moreland.

The data shows that canopy cover has generally increased across all land cover types, but is much more significant for street trees and park trees. Private realm tree canopy loss is of concern, especially given it makes up the largest land cover type. Declines are most pronounced in Pascoe Vale, Glenroy and Hadfield with urban consolidation the main cause for this decline. Interestingly private tree canopy has bucked the declining trend in Brunswick East and Coburg North where it has increased. The other interesting findings from this canopy analysis are the declines in street trees in Pascoe Vale and especially Brunswick West. The mapping exercise revealed that cross overs were a major contributor in Pascoe Vale whereas power line clearance and the recent Tulla Widening project explained the declines in Brunswick West.

It is important to view the percent change figures relative to the total contribution of tree canopy for each category. Both street tree and park tree canopies are coming off very low bases, so even with positive percent change in these two categories in Fawkner and Glenroy, the total canopy in these two suburbs has continued to decline.

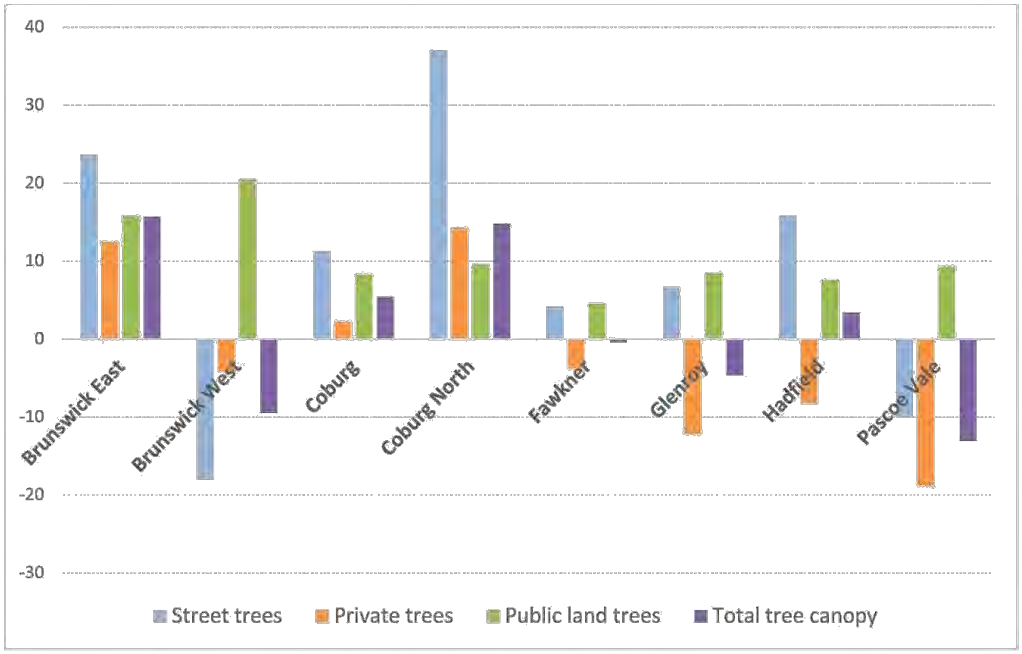


Figure 16. Canopy cover change for Moreland suburbs (SA2) between 2011 and 2016 by land-use category (% change)

Under a tree canopy saturation scenario, Moreland's street trees alone could potentially provide at least 14% canopy cover of the municipality or 75% streetscape canopy. This could be achieved by utilising larger tree species selection for vacant planting sites and when replacing underperforming or senescing trees. Because urban trees often take up to 30 years to reach a mature canopy, a more realistic 2050 goal is around 13-15% from street trees with a further 5-7% from park trees. This would be equivalent to a City of Melbourne tree canopy figure of around 50% and could be achievable by 2050 with the maturity of the urban forest.

Practical tree canopy saturation of our streets and parks could achieve 14% and 6.6% respective canopy cover.

Canopy analysis identified a further 14% plantable opportunities on private land and 15.6% plantable opportunities in Council parks and streets.

The optimised planting of larger canopy trees would increase the amenity values of street trees from $270 million currently to over $1.2 billion by 2050 and deliver over $4.6 million in direct environmental benefits annually.

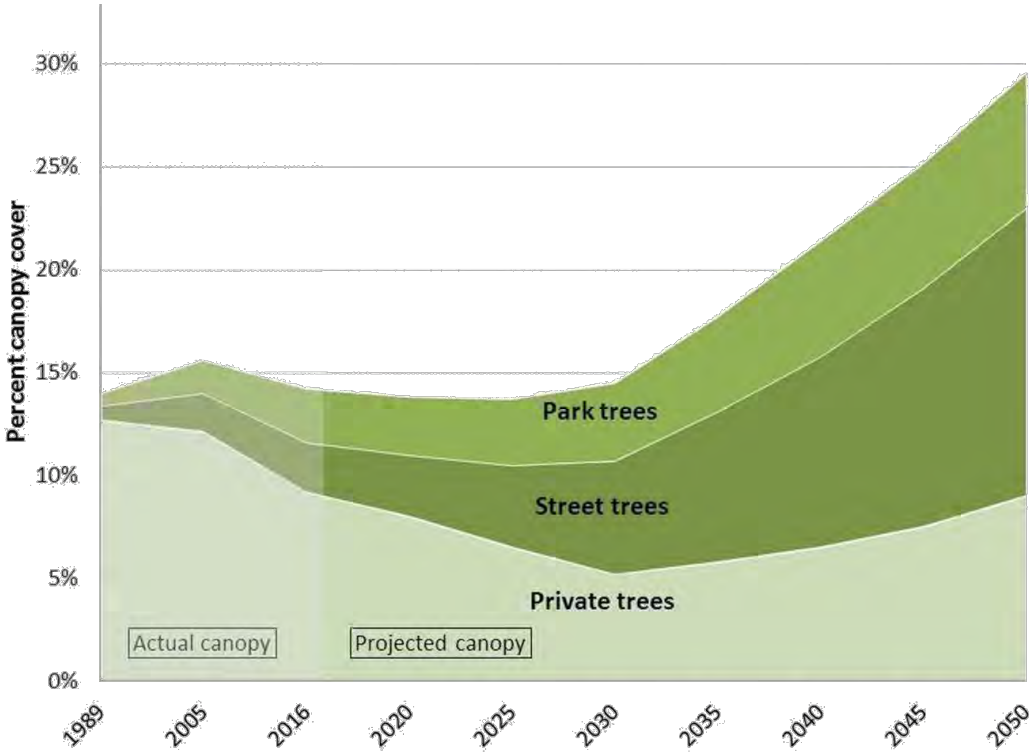


Figure 17. Urban forest canopy cover change in Moreland including projected canopy cover under the Urban Forest Strategy, 2017-2050

Council's team of qualified Arborists undertaking programmed pruning and tree removal works to reduce risks to the community and infrastructure

7. MEASURING THE VALUE OF THE URBAN FOREST

The tree assessment in 2016 provided tree attributes which help determine the dollar value of Moreland's street trees. iTree Eco provides a dollar value for the environmental benefits of trees including current environmental functions, longevity and overall performance of the forest. All amenity valuations were calculated using the City of Melbourne Tree Amenity Formulae.

The analysis of the current urban forest sets a benchmark against which future projections and performance will be measured.

Table 2 provides a summary of the environmental and amenity values of the current street tree population. It shows that Moreland's 60,000 street trees are worth an estimated $271 million in amenity value and provide the community with $361,073 worth of environmental benefits annually. The amenity value recognises that trees are a significant asset. The monetary amenity value has been based upon an internationally accepted value that relates to the trunk diameter and weighted according to a number of relevant considerations including species, aesthetics, location and condition. Revenue from amenity values supplements the tree maintenance program to maintain the overall asset value of Moreland's Urban Forest.

Table 2. Environmental and amenity values of current street trees prior to 2016 planting season

Estimated 2016 Street Tree Population	54,313
Total Canopy Cover (m^2)	813,843
Carbon Storage (kg)	11,328,569
Annual Carbon Seq. (kg/yr)	912,080
Amenity Value	**$271,179,839**
Annual Heating (kWh)	187,193
Annual Heating (A$)	$65,646
Annual Cooling (kWh)	784,378
Annual Cooling (A$)	$273,800
Annual Heating & Cooling (kWh)	971,571
Annual Heating & Cooling (A$)	$339,446
Annual Pollution (kg)	5,839.7
Annual Pollution (A$)	$2,504
Annual Avoided Runoff (m^3/yr)	8,412
Annual Avoided Runoff Value (A$)	$19,124
Most Common Tree	*Callistemon (22%)*
Average Trunk Diameter (cm)	21.2
Average Height (m)	4.7
Average Canopy Width (m)	3.0

Table 2 provides a summary of some of the current values of street trees in Moreland City Council. Figure 18 and 19 quantifies the significant air pollution benefits of Moreland's street trees. For example, every year more than 2.5 tonnes of ozone and 2.3 tonnes of air particulates are removed by our street trees. These are the same pollutants that cause serious respiratory problems for our residents. Our urban forest also plays an important role in removing carbon dioxide from our atmosphere by storing over 11 tonnes of CO2 and removing a further 912 tonnes annually. This is equivalent to removing the pollution produced from 4,066 cars from the streets of Moreland every year.

Figure 18. Air pollution removed by Moreland's street trees every year, kg

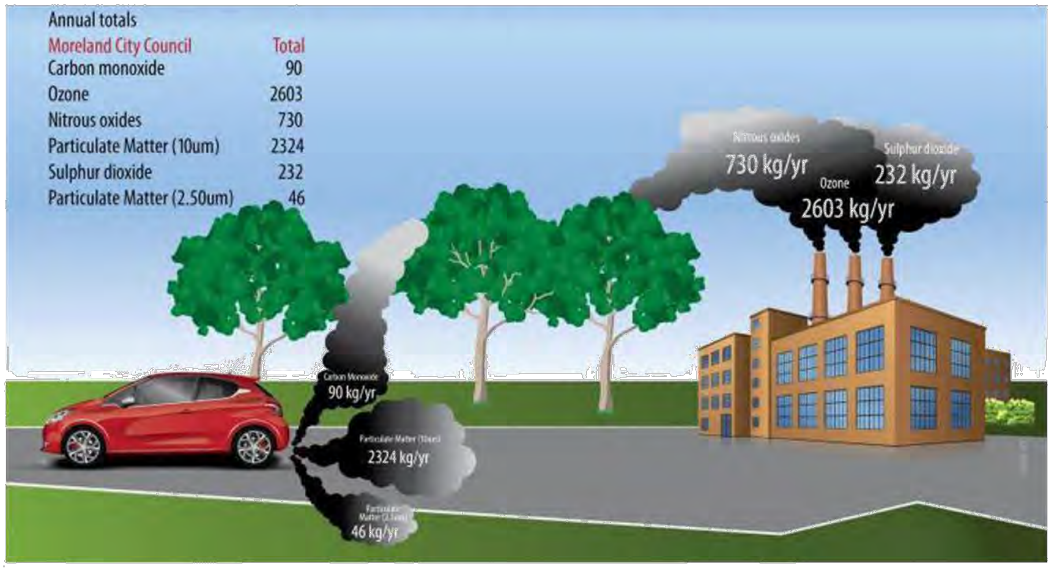
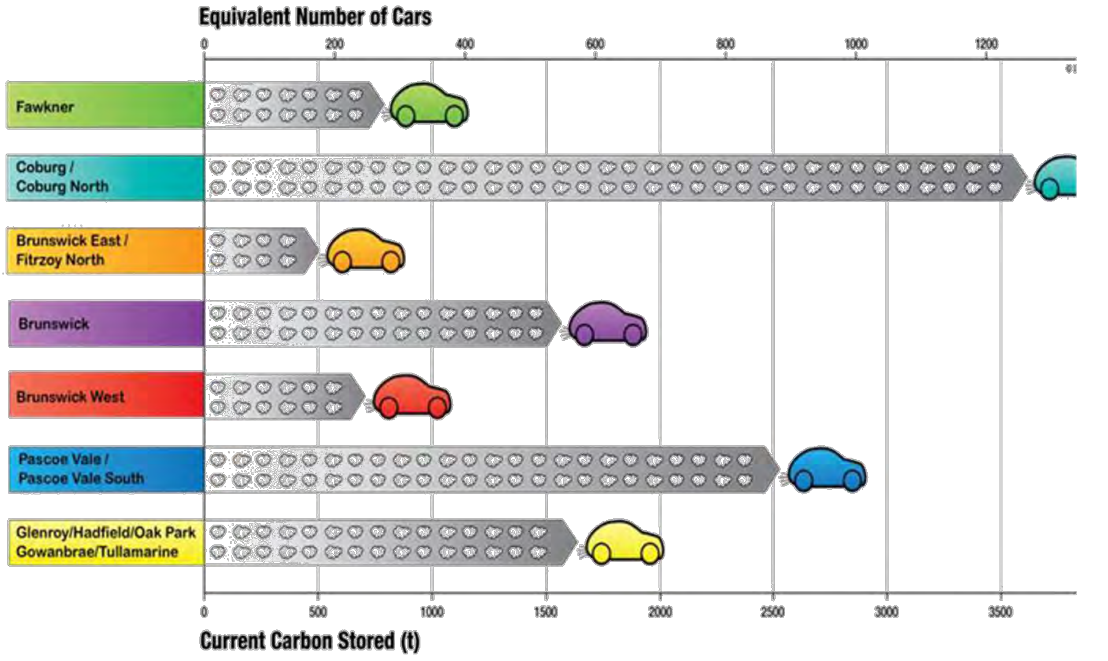


Figure 19. Carbon dioxide (CO2) removed and stored by Moreland's street trees every year, cars and tonnes



28

8. CHALLENGES

URBAN CONSOLIDATION

The process of urban consolidation across Moreland, and the rest of Melbourne, has resulted in the steady decline of vegetation in the private realm with a reduction in the size of front and back yards as well as a lack of setbacks to cater for vegetation and canopy trees.

While the canopy work has revealed a decline in private tree canopy especially in Glenroy and Pascoe Vale, there are some positives with a growth in Brunswick East and Coburg North. At the same time, many of the new developments in the Activity Centres are creating communal open space as well as roof gardens (see Reference Document 1 Green Roofs). While most of these spaces are constrained by the built form and competing services that limit soil volumes and tree canopy, there are also opportunities that can be realised through greening improvements in former industrial areas which were often completely impermeable and devoid of vegetation.

The results in Figure 12 highlight the increased and ongoing pressures that urban development is exerting on private green spaces and private trees; and the increased reliance on council parks and road reserves to provide canopy cover and community access to green infrastructure. Council needs to understand these shifts in canopy cover from a strategic planning perspective in terms of the protection of existing canopy trees and also the provision of new canopy trees in approved planning applications.

This is particularly critical in and around activity centres where footpaths and road reserves are often narrow and already congested with competing services.

A review of the 2009 Moreland Residential Landscape Guidelines and the Moreland Tree Planting Manual for Residential Zones 2014 is recommended as part of the scope of the Working Group. A review of these reference documents should improve both retention possibilities as well realise new opportunities for the planting of appropriate canopy trees on private land.

The location of electric lines within the municipality has an adverse effect on existing and the creation of avenues of significant street trees. Some of the electric lines in significant avenues have been converted to Aerial Bundled Cable (ABC). Insulated open span low voltage construction (tree cable) has also been installed in some areas. There is also high voltage aerial bundled cable (HVABC) in small amounts in various locations.

The undergrounding or bundling of powerlines with all new developments can ensure that these services do not further limit the provision of tree canopy on adjoining streetscapes.

This Strategy recommends the establishment of a working group to review a range of mechanisms and actions such as the planning scheme, local law, educational, incentives and other programs to provide stronger protection of existing private vegetation and introduce new programs to encourage planting on private land.

Climate change is predicted to increase the intensity and frequency of storm events which will have implications for Council. In October 2016, Melbourne experienced 12 storm events which is well above the long-term average of three events.

CLIMATE CHANGE

Moreland's urban forests, like all ecosystems, are impacted by climate change that includes increasing global air temperatures, increasing atmospheric carbon dioxide concentrations, changes in the patterns and amounts of annual precipitation, more frequent and intense storms, longer and more intensive droughts and heat waves, and changes in the frequency and severity of wildfires (IPCC, 2016). The impacts of severe storms and altered fire frequencies, particularly in peri-urban areas, will be profound (Moore, 2011).

The impacts of climate change on urban forests will not be uniform on either a national or global scale, which will make decisions related to planning and managing urban forests difficult as there will be few, if any, approaches that will apply globally, across a continent or across a nation. We continue to improve our understanding of the impact that these changes are having on trees growing in cities.

Moreland has already experienced increased temperatures, changes to rainfall patterns, greater storm intensities and droughts. In recent years, summer senescence has noticeably increased across a range of species due to prolonged drought and extreme heat. Tree mortality due to the 1999-2009 drought resulted in a significant increase in annual tree removals across Moreland.

Kendal (2016) found that two groups of popular urban trees are likely to struggle under climate change:

- Species from colder climates, such as northern Europe and the north-eastern United States.
- Species with narrow climate envelopes, such as many locally indigenous and other native trees

Kendal (2016) recommends the selection of a diverse range of trees that are likely to: perform well to increasing temperatures; maintain or improve ecosystem services and ecological functioning; and strengthens the municipality's adaptation and resilience to climate change.

Table 3 lists some implications on the management of the urban forest during climate change which should be relevant to Moreland. Management responses to reduce the risk of failure can include improving:

- tree establishment and formative care
- water availability through passive irrigation
- deep soil volumes, and
- tree species selection

While there is good reason for concern over the impacts that climate change might have on urban forest tree species, there are also reasons for optimism. Many species that are widely planted in cities are renowned for their wide tolerance ranges and they should cope with the level of changes in temperatures and rainfall that are projected for many cities.

Other common urban trees come from populations that have wide and extensive natural distributions. Careful provenance selection and breeding, which source specimens growing on appropriate soils but from lower rainfall or warmer regions should ensure that there are suitable intraspecific selections to meet urban planting demands. Even if species' ranges are limited, there may be the option of selecting different species from within a genus. This is the case with the genera, Eucalyptus and Acacia within Australia, where there are large numbers of related species occupying a broad range of habitats.

For many species higher temperatures will allow more rapid establishment and growth if water is available. Rapid tree establishment would be an advantage in many cities, provided efficient irrigation was available if required during establishment.

Frost sensitive species may be grown more widely and easily. For species with temperature dependent fruit or seed set, higher temperatures may result in trees that flower but which do not produce fruits and seeds which might be a nuisance.

Table 3. Simplified decision matrix for managing trees in the urban forest during climate change

Species characteristics	Tolerance of higher temperature	Tolerance of drought or lower rainfall	Likely impact of climate change	Management implications	Species example
Widely dispersed over a broad range	High	-----	Low	Select propagation material from appropriate provenance	*Kurrajong* species
Restricted range	Low	Low	High	Monitor performance and consider related species with tolerance of warmer, drier conditions	*Eucalyptus leucoxylon*

30

Species characteristics	Tolerance of higher temperature	Tolerance of drought or lower rainfall	Likely impact of climate change	Management implications	Species example
Drought prone	High	Low	High	May only survive if irrigated. Not recommended.	*Ficus macrophylla*
Drought resistance	Low	High	Moderate	Grow in shaded, cooler parts of cities	*Waterhousea floribunda*
Seed set	Low	Moderate	Moderate	May be an advantage when fruits or seeds are problematic in cities	*Prunus* species
Photosynthetic rate	Moderate	Moderate	Low	May be an advantage with higher establishment and growth rates. Could be enhanced with irrigation	*Tristaniopsis laurina*
Respiratory rate	High	Moderate	Moderate	Enhanced tree establishment and growth through efficient irrigation	*Ulmus parvifolia*
Transpiration rate	High	Low	High	May only survive if irrigated	*Ulmus procera*
Frost sensitive when young	Moderate-High	Moderate	Low	Small, young trees may be grown without protection from frost	*Buckinghamia celsissima*

There will be winners and losers among commonly planted urban trees species. In the fourteen year period of below average rainfall and above average temperatures experienced in south eastern Australia (1997-2010), many older conifers such as *Pinus radiata* and *Cupressus macrocarpa* died and urban populations of *Platanus* x *acerifolia* were deleteriously affected. Both Australian native and exotic species will be affected by climate change.

VEGETATION, URBAN SOILS AND WATER

Urban Soils

Moreland City Council predominantly has one of three surface geologies, with the soil profile in each closely related to the underlying geological material on which they have formed. Typical soils in Moreland comprise of dark grey sand over clay (Tertiary), light grey loams over clay (Silurian), and heavy clay (Volcanics). There are also smaller areas associated with alluvial flats and Tertiary volcanics are found in the slopes and bottoms of creek lines.

Soil disturbance, and extensive exporting and importing of soil material have commonly occurred throughout the municipality, resulting in highly modified , and often unpredictable, soil profiles. These Anthroposols or human modified soils are the predominant soil profiles that trees are planted into within the streetscapes of Moreland. These soil types can have degraded soil chemistry, nutrition, and structure, which can negatively affect tree health.

Unfortunately, soil contamination is a legacy of certain historic land uses and vehicle pollution in many urban soils or anthroposols across Moreland. Depending on the nature and extent of the contamination, and how the site is to be used, contaminated sites may pose risks to human health and the environment. Key considerations regarding managing risks pertaining to the management of contaminated soil include knowing where these sites are, whether they are contaminated, the extent and type of contamination and the potential impact on human health, the environment or amenity. Testing, managing and remediating contaminated soil can be very expensive.

To compound matters, urban areas are dominated by concrete, roads, buildings and other sealed surfaces that prevent the permeability of water and oxygen.

To facilitate improved soil environments around existing trees, soil health guidelines have been prepared to facilitate improved soil conditions and promote better tree health (See Reference Document 1).

Urban Water

Water is essential in keeping our urban forest and green spaces healthy and cooling the city. The sustainable use of water is directly linked to liveability.

Water availability in urban Melbourne is a mix of climate variability and an abundance of stormwater.

Over the past 50 years we have seen a reduction in rainfall in southern and eastern Australia, more frequent heatwaves, fewer frosts, warmer temperatures, an intensification of drought conditions, and rising sea levels (CSIRO & BOM 2016).

The impact of increased water evaporation from plants and soil and the decrease in rainfall is also likely to diminish soil moisture. Combined with more extreme rainfall events it is also likely that this will lead to high levels of water runoff, limited infiltration of water through soil and an increased possibility of flooding events.

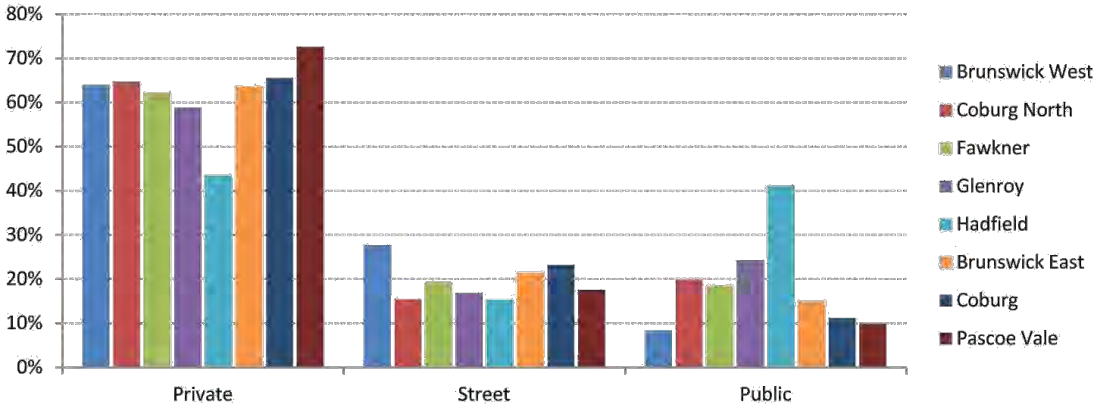
To manage these issues Council need to carefully consider how and when to use water. It is not a case of ceasing the use of water, but about considering alternative sources of water (such as stormwater) and how efficiently and effectively it is used to achieve the desired outcome.

LAND USE: OPPORTUNITIES AND CHALLENGES

Table 4 shows the current land use for 8 Moreland suburbs (SA2) and shows that the majority of Moreland is comprised of private land, ranging from 43% in Hadfield to 73% in Pascoe Vale. The Hadfield figures are significantly different due to the large area of the Fawkner and Northern Memorial Park.

Public land (including parks and public buildings) occupied the smallest proportion of each suburb, ranging from 41% in Hadfield to as little as 8% in Brunswick West. Public streetscapes covered between 28% in Brunswick West and 15% in Coburg North (Table 4).

Table 4. Distribution of land-use areas for 8 Moreland suburbs (SA2), 2016



A more detailed breakdown of the land cover types is shown in Table 4 shows that buildings and hardscapes (i.e. roads, footpaths and car parks) cover 54% of the municipality.

The canopy assessment also identified a further 23% of Moreland where trees could potentially be planted, which includes a further 14% plantable opportunities in the private realm and 9% in the public realm. The public realm plantable opportunities figure of an additional 9% cover needs to consider the place and value of open space areas with grass and vegetation rather than just trees.

It is important to understand that trees can play a greater role in shading hardscapes and that it is not a zero-sum outcome where tree canopy results in the loss of roads space. In addition, there is significant scope for improving tree canopy cover over hardscapes in a complementary manner. While there are always constraints that need to be considered, the aim of the street tree plan is to provide greater canopy shade for Moreland's streetscapes.

These land use figures presented in Table 4 are important to consider when understanding change over time in canopy cover but also the scope for increasing tree canopy in the public realm, namely street and park trees.

BIODIVERSITY

Climate change is likely to amplify existing threats such as habitat loss and invasive species, making their impacts considerably worse.

Loss of biodiversity is a real threat in a changing climate. The effects of climate change on the biodiversity of Moreland's urban forest will occur at many different levels – from individuals to ecosystems. Species may alter distribution, abundance, behaviour and the timing of events such as migration or breeding. The most susceptible species will be those with restricted or specialised habitat requirements, poor dispersal abilities or small populations.

Urban consolidation, loss of backyards (which often provide good habitat linkages for fauna in particular) and incremental loss of vegetation to infrastructure make it difficult to maintain biodiversity. As Moreland's population continues to grow and the climate warms, it will become increasing important to provide refuge and connectivity of habitat for biodiversity.

Moreland City Council focuses on the preservation of habitat trees and a number of sites are registered in the 2011 Moreland Indigenous Vegetation Assessment Final Report.

Council recognises the importance of appropriate training for its own Arborists to ensure programmed pruning and electrical line clearance pruning is sensitive to the protection of habitat. Therefore, Council is introducing a training program for staff to recognise habitat sites and incorporate best practice in mitigating the effects of line clearance and pruning on native habitat.

There is scope for improving the planting of habitat canopy trees to connect open space and waterways but it is also important to acknowledge the important role of private gardens, nature strips, railway corridors and road plantations.

Climate change will also have indirect impacts on urban forest biodiversity. There may be increased pressure from competitors, predators, parasites, diseases and disturbances (such as bushfire or drought). It is likely to influence the composition of ecosystems and their distribution by altering water flows in rivers and wetlands and the occurrence of bushfires and floods.

RISK MANAGEMENT

A key issue confronting the community is how to manage the urban forest from a landscape, ecological and public safety perspective ensuring that reasonable care is taken to manage the risks associated with the urban forest.

Risk can be defined as the future 'possibility that things can go wrong or not turn out as expected' (Power 2004, p.61). It is a complex term that can refer to harm, security, safety, an uncertain future and a desire to control current and future outcomes. Risks within the urban forest may relate to the likelihood of a street tree limb drop impacting upon persons or property, the loss of trees due to pest and disease, higher mortality and morbidity rates from the lack of vegetative shade and cooling, greater obesity rates from lower activity levels due to poor streetscapes and open spaces, and fires in open space for example. An emerging weakness of risk management is that it is increasingly focused on mitigating reputational damage of organisations and management who perceive that delaying or not making a decision reduces their risks. As such this response often diverts energy and resources away from the management of societal risks.

For Council, managing risk is about improving decision making, governance, resourcing and productivity. The important questions we need to answer in responding to risk are: the risk 'of what', 'how likely' and 'how serious'? In regard to an urban forest, risk management requires a shift in values away from trees as a liability to an asset, and for Council to move from reactively managing trees individually to strategically managing it as a whole or urban forest.

Moreland City Council manages over 130,000 trees including 59,000 street trees within a range of landscapes. In the majority of cases, the large numbers of trees prohibits an individual tree assessment approach. The time involved in the inspection procedure and the works generated from such inspections would be extensive and prohibitively expensive for the community. A broader, systematic and proactive approach to tree assessment is required that prioritises works on hazardous trees based on the establishment of tree risk.

Trees die from a range of causes including disease, insect attack, disease, drought, uprooting, poisoning and catastrophic stem failure in high winds, or more often a combination of factors working together. Limb failure can sometimes be an early sign of poor health.

Traditional grey infrastructure like roads, drains and buildings have often been monitored and assessed for acceptable levels of risks. Common risk management frameworks include Risk Management Standards and Guidelines (AS/NZS ISO 31000 Standards Australia 2009) and the International Risk Governance Council's Risk Governance Framework (IRGC 2005). In recent decades, specific techniques have also emerged in regard to identifying, assessing, analysing and managing risk in regard to the urban forest. Specific risk management frameworks relating to the Urban Forest include, for example, a Visual Tree Assessment.

Council uses a range of advanced procedures, techniques and equipment to manage risk in regard to our trees, including for example programmed tree pruning, decay-detection equipment, tree surveys and inventories, training, amenity tree valuations, hazard assessment, tree inspection, tree and landscape management plans, tree maintenance and monitoring schedules, contractor supervision, review protection plans for trees on development sites, root mapping; and arboricultural engineering.

Two terms that are often used when referring to trees and risk are hazard trees and tree defects. A hazard tree refers to a tree that has structural defects in its stem, branches or roots that may cause the tree or tree part to fail, and where such failure may cause personal injury or property damage. There are two kinds of tree defects: (i) injury or disease that seriously weakens the stems, branches or roots of trees, predisposing them to fail or (ii) structural problems arising from shallow rooting habits, inherently brittle wood, or poor tree architecture, including V-shaped crotches in stems and branches that lead to weak unions, etc.

The perception of safety or acceptable levels of risk is equally or sometimes more powerful than the reality of the condition of a tree and the situation that it is growing in. People without Arboricultural training are often involved in making decisions in regard to the urban forest that are based on local politics, emotions, and perceptions of safety. In order to make objective, science-based decisions on the safety of trees and the urban forest, individual trees and site conditions need to be assessed for the level of risk that they do or do not present by qualified Arborists.

A tree risk management program provides a systematic process for scheduling and inspecting trees, enables the prioritisation of works based on perceived risk, and allows judicial use of community resources. The fundamentals of tree risk management involve:

- Regular assessment and documentation with prioritisation of works;
- Appropriate tree selection and allocation of suitable space; and
- Properly maintained trees.

The need for crisis management can be alleviated by having in place a tree risk management process that

aims to avoid, rectify or remove tree defects before they become hazardous.

An emerging challenge for Council is managing the implications of increasing the size and canopy of the trees it is planting on Moreland streets. Not only does Council need to meet landscaping and ecological considerations, but it needs to maintenance programs are adequately resourced and reasonable care is taken to manage the risks associated with hazardous trees and the impact of trees to community safety and on other assets.

Council assesses the level of risk ranging from low to high. For example, Council risk trees are under power lines, around schools or major roads, in playgrounds and sports fields, shopping precincts and near council facilities. These trees are audited annually.

Since 2014, the threshold for removing trees has been adjusted with a higher priority on tree retention. Previously, simple limb failure may have resulted in removal whereas there is a now a more technical response. The shift in attitude has occurred due to the professionalization of tree crews to employ skilled Arborists and a greater understanding of the overall integrity of the urban forest.

Quality tree management is probably the most important risk management program undertaken by Council's Open Space Unit. It starts before we even plant a tree (discussed in more detail in Reference Documents 1) and covers tree species and site selection, tree planting, tree pruning and maintenance, and our emergency response programs. The benefits of choosing to manage the risks of an Urban Forest through such an approach include the following:

- Lower frequency and severity of accidents, damage, and injury;
- Fewer expenditures for claims, and legal expenses;
- Healthier, longer-lived trees; and
- Overtime, fewer tree removals annually.

Despite this Council has adopted a systematic and proactive approach to tree assessment that prioritises works on hazardous trees based on the establishment of tree risk process. Moreland's tree risk management program provides a systematic process for scheduling and inspecting trees, enables the prioritisation of works based on perceived risk, and allows judicial use of community resources.

35

The key aspects of Moreland's tree risk management process include:

- Regular assessment and documentation with prioritisation of works,
- Appropriate tree selection and allocation of suitable space, and
- Properly maintained trees.

The tree risk management process aims to avoid, rectify or remove tree defects before they become hazardous.

PEST & DISEASE MANAGEMENT

The monitoring, containment and treatment of pest and disease attacks on the urban forest is important. Maintaining a diverse street tree population and improving tree selection, planting and maintenance programs will help to minimise the impact of any new pest or diseases. Elm Leaf Beetle management programs are already in place. Myrtle Rust, a serious exotic fungal disease was first detected in 2011 in Melbourne could have a significant impact on many species within the Myrtaceae family which dominate Moreland's urban forest. Ongoing monitoring is critical for all pest and disease issues. Further details are discussed in Reference Document 1.

RISK ASSESSMENT MATRIX OF TREES

Trees are living, dynamic organisms that pose some risk of harm to people and property. There are many factors that affect the level of risk associated with trees including the time of the year, extreme weather and previous maintenance works.

Overall risk from trees is extremely low. Norris (2010) compiled statistics from a 53 month period and calculated the fatality rate from accidental tree failure in an urban area at 1:17.7 million annually during that period.

Management of unreasonable risk is an appropriate response; however, the elimination of all risk from trees in our community is not practical or environmentally sound, as this would require the removal of many trees in the community. This is not desirable as the very small risk that the population of trees represent is outweighed by the benefits that the trees provide.

Risk versus Hazard

There is often confusion between risks and hazards when assessing risk. Risk and hazard are not the same. A hazard is the presence of, or ability of, something to

cause harm. With all mature trees, there may be a hazard present, just as there may be with any man-made structure. For example, the ceiling of a building could fall into a room. This is a hazard. It is a hazard that, if it falls on a person, will most likely cause some level of injury. This injury is classified as a consequence. The likelihood of the ceiling failing is extremely remote. The likelihood of the ceiling failing when it could cause an injury is even more remote, as the room will not be occupied at all times over a 24 hour period.

The combination of the consequence and the likelihood is the risk. In the example above the risk is so small that a reasonable person would take no particular action to avoid the risk. A risk assessment aims to categorise risks to identify risks that are unacceptably high. A decision then can be made on the most appropriate way to manage the risk down to an acceptable level.

Risk assessment

A tree risk assessment is undertaken to identify trees that pose a risk of harm to people or property that is greater than the risk threshold that is acceptable based on normal community standards of risk and any specific factors for the particular tree or location.

There are a number of approaches to urban forest risk assessment. A standardised and systematic process for assessing tree risk is the International Society of Aboriculture's Tree Risk Assessment Qualification (TRAQ). Such processes ensure the results of a tree risk assessment provide the community and assessors with sufficient information to make informed decisions to enhance tree benefits, health, and longevity.

The risk assessment takes into account the hazard from the tree, and in particular, any factors that increase the hazard of that particular tree from the general population of trees. These factors will include tree health, tree structure and the presence of observable dead or broken branches, cavities or structural issues. The risk assessment also takes into account the magnitude of harm that may occur from the most likely hazard posed by the tree and the likelihood of that harm occurring based on the type of target (e.g. person, building) and how often that target is likely to occupy the target area.

Mitigation measures are recommended for trees that have been identified as an unacceptable risk in order to reduce the risk to an acceptable level.

While inspecting and assessing each tree a risk assessment was completed. The risk rating is allocated to help assess the risk the tree or group of trees pose to the target. For details of the risk assessment criteria see Reference Document 1.

The formula is (Likelihood of Failure * Likelihood of Impact)/2*Consequences.

When conducting the assessment the part of the tree that is most likely to fail within the inspection period is assessed and rated. The inspection period for this assessment has been deemed at 36 months.

TREES AND OTHER ASSETS

The urban forest is subject to a variety of pressures, conflicts, changes to land-use and public requirements. These pressures lead to damaged trees, which may affect their function and viability in the landscape. The conflict between tree roots or canopy and infrastructure is pervasive in urban areas. The increase in urban development linked to the need and desire to have trees in our landscapes will invariably lead to conflicts.

Understanding the various causes of infrastructure damage will allow the most appropriate actions to be developed to minimise the risk of damage occurring. A range of strategies need to be considered such as appropriate species selection and site assessment, root pruning and barrier placement to avoid or manage tree root conflicts with infrastructure.

Most of Moreland's streets include above ground power and communication cables. Council has legislative clearance requirements for trees around powerlines. Electricity Safety (Electric Line Clearance) Regulations 2015 (Energy Safe Victoria). This requires regular clearance pruning to attain required clearance distances. As the population increases and urban consolidation occurs there is also pressure to increase the size and number of vehicle cross overs, which can add pressure to existing trees. Co-ordination with service providers and other council departments is required to ensure the sustainable management of street trees.

Planting Guidelines in Reference Document 1 provide recommended setbacks and clearance requirements for a range of infrastructure.

ROAD SAFETY

Roadside trees do not appear to comprise a significant risk to drivers. Instead, they encourage lower speeds and are now accepted and used as effective traffic calming devices. Traffic authorities have tended to severely restrict roadside tree planting by enforcing 'clear zones' to be kept free of rigid objects such as trees above a specified trunk diameter. As a consequence clear zones are seen as the largest impediment to roadside tree establishment on arterial roads. In 2007 in NSW tree crashes comprised only 4.4% of all crashes with a fatality rate of 3.1%. Alcohol, speeding and driver fatigue were the biggest contributing factor to fatal crashes. The tree tends to be unfairly blamed as the cause of the accident, when in fact the tree collision is only the outcome of a run-off-the-roadway incident.

Street trees, if properly selected, adequately spaced and pruned to branch high, do not create major visibility problems for drivers entering intersections. In fact parked cars, especially large vehicles such as 4WDs and SUVs, create substantially more visibility problems.

In fact, the presence of trees encourages people to walk for both exercise and transport and is associated with reduced incidence of heart attack and type 2 diabetes.

Moreover, trees planted along the kerb, especially if closely spaced; define a pedestrian zone separated from traffic, creating a sense of safety both physically and psychologically. The perception of safety is an important component of walkability, and there are safety aspects of tree planting in the verge between the footpath and roadway. This includes an increased perception of safety, by separating pedestrians and moving vehicles, and by creating a protective barrier which reduces the risk of being hit by a 'run-off-the-road' vehicle.

ROAD STABILITY, FOOTPATHS AND ROOT INCURSION

Pavement damage due to tree roots has budgetary implications for local government. Costs include pavement repair, tree removal and replacement, legal expenses, and injury claims (Foster, Lowe & Winkelman 2011).

At the same time, research challenges the common assumption that pavement cracks near roots are always caused by trees. Footpath damage can result from soil conditions and age of pavement as well as from tree roots. D'Amato and others (2002) found that older footpaths fail more often; and footpaths did not fail at higher rates where trees were present. With no roots present, 61% of all pavement expansion joints were also cracked.

Council receives a number of claims every year for alleged damage caused to buildings by trees. Such claims and damages put financial pressure on Council but also cause resident angst and frustration.

There is a need for strategic response. Moreland's soils are dominated by high reactive clay which can experience significant shrinkage and expansion due to changing soil moisture.

9. PLANTING OPPORTUNITIES

After the 2016 planting season, it is estimated that 58,702 trees are currently growing within Moreland's streets with a further 7,258 potential planting locations available. If all of these vacant sites are planted, then Moreland's streetscape should be basically saturated with 65,960 street trees, including 941 potential planting sites that could be developed in non-conventional nature strip sites (e.g. in road plantings). These vacant sites represent missing environmental and amenity value to Moreland City Council, and if strategically planted could provide more than $657,000 of annual environmental benefit to the community.

- There are currently 6 trees for every vacant site across the municipality
- There is a disproportionate distribution of vacant plantings between suburbs with Gowanbrae, Tullamarine, Glenroy, Hadfield, and Oak Park having a tree to vacant planting ratio of 3:1

It is likely that additional vacant sites could be identified, most of which will require design and capital works, particularly in the three activity centres.

Table 5 provides a summary of the estimated status of street trees and potential planting sites within Moreland City Council, based upon existing inventory data and a 2016 stratified sample survey of 4,769 street trees and an earlier sample of nearly 10,000 trees. Details of data sets and sampling methodology are provided in Reference Document 1.

Table 5. Street Trees and Vacant Planting Sites

Tree Status	Description	Total	Percentage
Current	Street trees	58,702	**89%**
Proposed	Potential future planting sites requiring design	941	1.4%
Vacant	Currently vacant planting sites	6,317	9.6%
Total	Future street tree population	65,960	100.00%

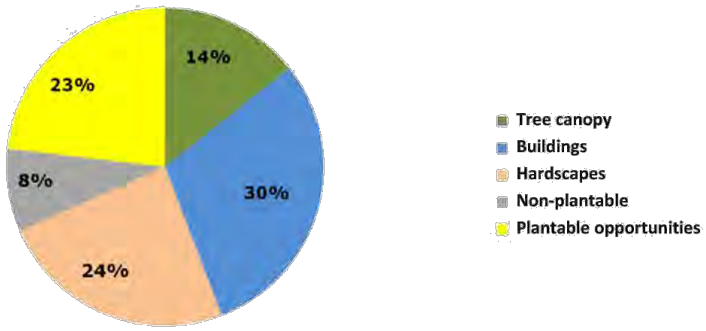
A complete field audit of every street in the municipality was conducted in 2016 to identify all current planting opportunities in conventional planting sites such as nature strips and medians, as well as areas with the potential for alternative planting treatments such as in-road planting and borrowed streetscapes such as park frontages. These will require design outcomes and are discussed in Street Tree Planting Plan.

Table 6 identifies a total of 9,140 currently vacant planting sites and 941 potential planting sites that were identified in early 2016 within Moreland streets.

Selecting tree species based upon the location of the planting site, its restrictions and tree functions will enable the most environmentally functional tree to be established to maximise carbon sequestration, pollution removal, passive energy benefits, canopy cover and rainfall interception; and facilitate targeted tree species selection to fulfil specific environmental needs e.g. high pollution removal along major roadways.

Further analysis is required to understand the full scope and priority for scheduling these potential planting sites against capital budget and local site constraints.

Figure 20. Moreland land cover types including opportunities for tree planting



The tree canopy results for 2011 and 2016 for 8 Moreland suburbs revealed a very distinct pattern where total tree canopy remained largely stable (-1.1% change) while streetscapes (+5.6% change) and public areas (+4.6% change) increased canopy cover and private areas lost canopy cover (-6.6% change). The loss in private realm vegetation was largely due to tree removal relating to construction activities. The steady pace of urban infill development is resulting in losses of tree canopy under private tenure, at a time when Moreland is trying to set ambitious targets to increase overall canopy. Despite Council's efforts to increase canopy cover in the public realm (streets and parks), the loss in the private realm is negating the overall impact.

The 'dynamic equilibrium' in tree canopy cover change whereby canopy losses are approximately offset by concurrent canopy growth, means that arguments around the setting of ambitious targets to increase the urban forest's canopy may be difficult to achieve without changes in tree protection and infill development policy and planning.

In 2016, Council introduced planning scheme amendments to all Residential Zones (RGZ, NRZ and GRZ) to provide for an increase in vegetation through a preferred "green" landscape character across the municipality. The amendment also recognised the function of landscaping, such as canopy trees by requiring the planting of a minimum of one semi mature canopy tree.

Moreland's street and park trees provide around 5% cover of all land areas. Based upon land data provided by Council, Moreland City Council nature strips occupy 6.2% of the total land area of the municipality, from which street trees are currently providing 2.4% canopy cover.

Glenroy and Coburg have the largest number of current vacant sites at 2,263 and 1,291 respectively. Over 23% of the vacant sites are located in Glenroy with a further 14.3% in Coburg with only 10% in Brunswick. The difference in vacant site numbers is largely due to the wider nature strips and footpaths that are located in Glenroy and Coburg. In contrast, Brunswick dominates in terms of potential vacant sites that will require a design outcome due to the often narrow streets and footpaths.

These vacant planting locations represent currently available and potential opportunities to increase the structural and functional value of Moreland streetscapes. These vacant sites are conservatively estimated and factor in many of the identified safe clearance and setback areas from existing intersections, services and other assets.

Table 6. Current Street Trees with Vacant Sites by Suburb and Ratio, 2016

SUBURB	2016 STREET TREES	VACANT TREE SITES

	(prior to 2016 planting season)	Current	Potential	Total Vacant Sites	STREETS TREES TO VACANT SITES RATIO
Brunswick	6,034	425	550	**975**	**6:1**
Brunswick East & Fitzroy North	2,930	326	56	**382**	**8:1**
Brunswick West	4,260	456	97	**553**	**8:1**
Coburg	9,525	1,291	154	**1,445**	**7:1**
Coburg North	3,823	784	0	**784**	**5:1**
Fawkner	5,910	778	0	**778**	**8:1**
Glenroy	7,203	2,263	72	**2,335**	**3:1**
Gowanbrae & Tullamarine	643	326	0	**326**	**2:1**
Hadfield	2,594	432	0	**432**	**6:1**
Oak Park	1,629	581	0	**581**	**3:1**
Pascoe Vale	5,618	887	0	**887**	**6:1**
Pascoe Vale South	4,044	591	12	**603**	**7:1**
Moreland Council Total	**54,313**	**9,140**	**941**	**10,081**	**5:1**

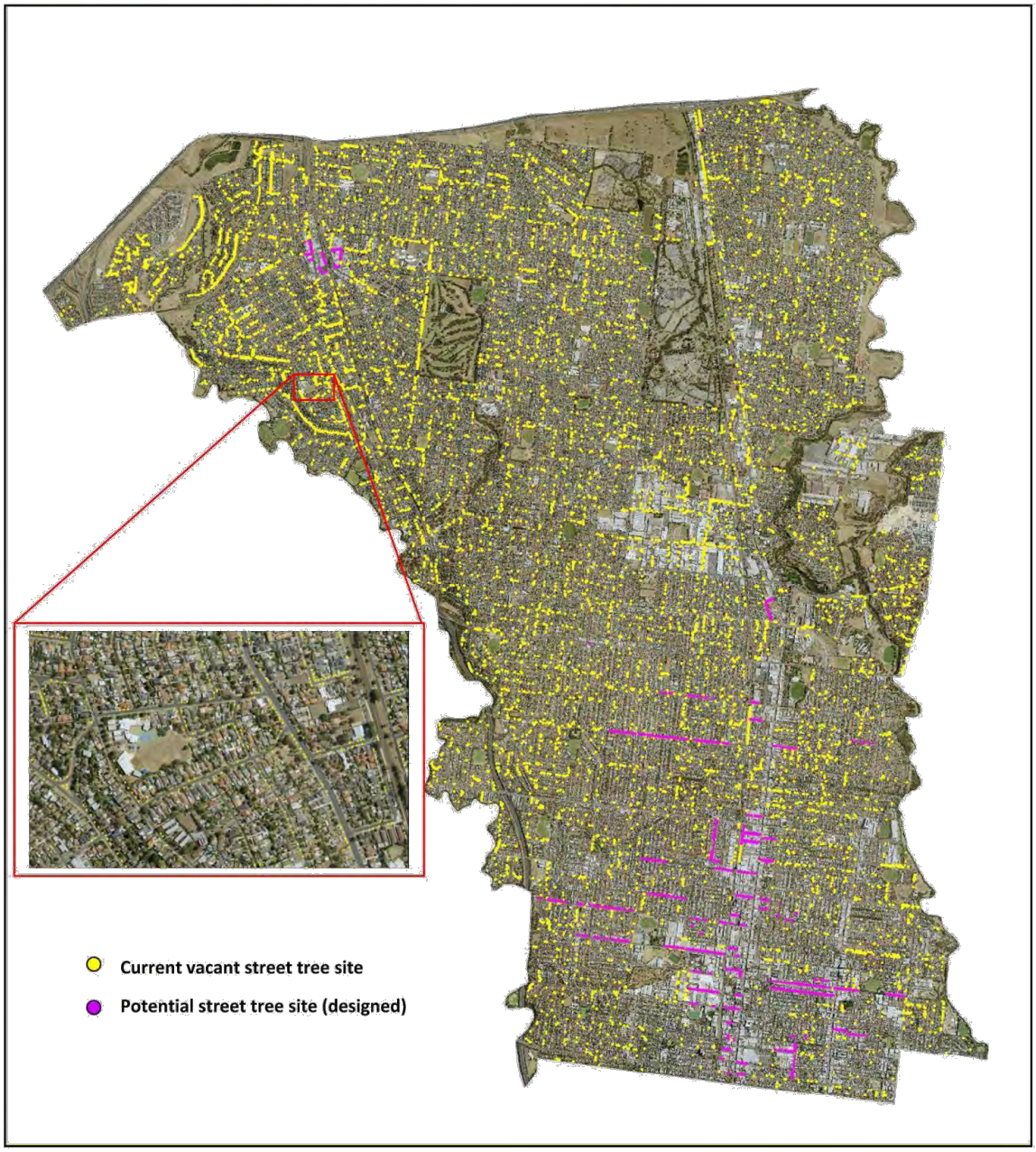
The current street tree to vacant planting site numbers shown in Table 6 represent a ratio of 5:1 (i.e. for every five trees planted, there is 1 vacant planting site). This ratio is acknowledged to be better than many municipalities around Australia, with a ratio of approximately 3:1 commonly identified.

Table 6 highlights the disparity of planting site vacancies between suburbs of Moreland City Council. Gowanbrae, Tullamarine, Glenroy, and Oak Park have the greatest rate of vacancy, with a 2:1 or 3:1 ratio identified (i.e. for every two trees planted, there is 1 vacant planting site).

While the high vacancy rate and low ratios can reflect more prevalent site restrictions for tree planting and the relative age of residential communities, they also highlight suburbs where significant improvement for tree density can occur.

All vacant planting sites and potential planting sites are identified on a map of Moreland in Figure 21, which provides a useful overview of vacant planting sites, and an example of vacant planting density in a sample area which has low canopy cover. The 9,140 sites highlighted yellow represent currently available sites that are vacant and the 941 purple sites represent potential planting locations in streetscapes that will require strategic design to facilitate tree planting are discussed in the Street Tree Planting Plan.

Figure 21. Current vacant plantings locations map across Moreland



10. NEIGHBOURHOOD CHARACTER AND THE URBAN FOREST

WURUNDJERI HERITAGE

Moreland's urban forest strategy acknowledges the Wurundjeri as the traditional owners of the land. We acknowledge their elders past, present and future. It is important that Moreland goes beyond the basic protection provided to Indigenous sites of significance through the Planning Scheme and Aboriginal Heritage Regulations and instead provide opportunities to identify historical and current connections to the land in partnerships with the Wurundjeri Council.

This Urban Forest Strategy acknowledges that we have much to learn and plenty of work to do if we are to repair the poor state of land that was occupied by and forcibly taken away from the Wurundjeri who had cared for the land for over 40,000 years. For this acknowledgement to be meaningful, Moreland will need to not only improve its protection of important cultural and environment sites but improve our engagement with the Wurundjeri people through a process of reconciliation, engagement, improved access to land, the adoption of traditional land management practices, place naming and the celebration of indigenous place and traditions. It is also important that Moreland provides appropriate protection of this living heritage (see Boxed Text: Murnong Harvest Festival.

Murnong Festival Harvest Festival

The traditional staple food of Aboriginal people of South East Australia, the Murnong (or Yam-Daisy) is now close to extinction on much of the grassy plains that spread across the northern and western district.

The annual Murnong Harvest Festival is a good example of celebrating place, cultural traditions and traditional plants which also acknowledges the strength and significance of ongoing access to, and celebration of, land and country.

Murnong and other plants that are important to the Wurundjeri people, are part of a cultural land restoration project on the Merri Creek on Connolly Avenue, Coburg by the Merri and Edgars Creek Confluence Area Restoration Group (MECCARG) in collaboration with the Wurundjeri Council.

Every year in November, the community celebrates the Murnong harvest festival and learns about and engages in Wurundjeri culture. Activities typically include: a tanderum ceremony; traditional dance performance and dreamtime stories; boomerang painting and throwing; spear throwing demonstrations; didgeridoo lessons; craft stalls; and of course the Murnong harvest and bake.

COMMUNITY VALUES

Moreland's community is incredibly rich and diverse as is their relationship to vegetation. On the one hand, the community are increasingly calling for more action to improve the amenity of streetscapes, increase vegetation cover, reduce the impact of the urban heat island effect and improve the protection and management of existing vegetation. On the other hand, there remains a strong aversion to tree risk with increasing demands from residents to remove large trees, complain about nuisance factors such as leaf litter, flower drop and are more litigious. At the same time, the community is increasingly sedentary with low maintenance balconies and courtyards more common than backyards. Every year, Council's arborists receive around 6,000 customer complaints that predominantly emphasise the negative concerns of the community.

Such divergent attitudes and shifts present challenges for managing the urban forest.

In 2017, Council commenced a three year research program led by the University of Melbourne to better understand community perceptions of vegetation across the municipality. This will be the first comprehensive assessment of community values of the urban forest and will be very useful in assisting Council in improving communication and the delivery of its tree maintenance and planting programs.

PARKS, HABITAT VALUES AND HABITAT CORRIDORS

Moreland is a highly urbanised municipality with few native vegetation remnant patches or scattered trees in comparison to peri-urban and rural councils that harbour similar Ecological Vegetation Communities.

Nevertheless, Moreland contains environmentally significant areas, in particular local creeks and their surrounding environs.

The majority of the municipality resides in the Victorian Volcanic Plain Bioregion which was predominantly covered by the Ecological Vegetation Classification Plains Grassy Woodland (55) which has an Endangered Bioregional Conservation Status. The protection of remnant vegetation and habitat enhancement to encourage insect, bird and animal populations is important. The Environmental Significance Overlay (ESO) applies to both the Merri Creek and environs (includes Edgars, Merlynston, and Campbellfield Creeks) and the Moonee Ponds Creek and environs (includes Westbreen and Melville Creeks). Plantings within the bounds of this overlay should focus on strengthening and protecting the environmental significance through selecting indigenous species of local provenance within parks and streetscapes.

Buffer zones have been created adjacent to these important natural areas to guide the selection of species and planting types within the parks and streetscapes of these areas (Reference Document 3).

Coordinating waterway, park and street tree plantings can encourage nature and provide links and expand areas of natural habitat for insects, birds and small mammals. The Urban Forest Strategy identifies habitat corridors and nominates appropriate species to provide such links (Reference Document 3). Our waterways and parks offer the best opportunity to grow a range of indigenous plant species, and these plantings and the juxtaposition of natural formations with the regular plantings of the streets will contribute to the richness of Moreland's urban design.

Caution must be exercised if planting non local species in these areas to prevent hybridisation with indigenous populations. It is acknowledged that these streets may have existing planting of exotic tree species and some contain significant avenues which perform a habitat function. It is not recommended that these species be removed as part of this strategy. Species with weed potential or a tendency to sucker should not be planted in the buffer zones. A list of species that this applies to is provided in Reference Document 1.

PLANNING SCHEME

Moreland's future urban forest will be partly shaped by Council's decisions today, just as current decisions are shaped by those previously made. As climate, population density and public health pressures increase, strategic decisions will need to be made that meet a range of needs for the future population ensuring that our public and private trees provide the greatest possible environmental, social and economic benefits to the community.

Council has in place some important policies and planning scheme controls to protect certain elements of Moreland's urban forest. To ensure that Council can maintain and improve its urban forest, a strategic vision is required to provide the framework from which the existing overlays, policies and planning scheme controls can operate. It will also provide a foundation for Council to consider alternative mechanisms and approaches to ensure that planning today contributes to the longevity and health of Moreland's future urban forest.

Optimal municipal wide management and planning for the urban forest must cover both public and private property - urban trees make no distinction between land tenure, yet tenure has significant effect upon individual trees and the canopy as a whole.

Moreland has been experiencing a sustained increase in housing density that has been shown to negatively impact on the amount of green space in neighbourhoods, particularly in private gardens. The subdivision process and design of new dwellings has resulted in a steady decline in private realm vegetation and canopy cover across Moreland during the past decade. Much of this vegetation will be lost forever because building footprints are very difficult to reverse. Moreover, developers and private owners are also replacing mature trees with trees or other vegetation that will not provide the same canopy cover and size of the removed vegetation (Brunner and Cozens 2013; DSE 2011).

Plan Melbourne 2017-2050 revises the 2014 version of Plan Melbourne to reflect current State Government policies and priorities. Linked to the release of Plan Melbourne 2017 was a review of the Residential Zones. The residential zones review found that the residential zones released in 2014 had been implemented in an inconsistent manner across Melbourne. The Minister for

Planning has advised that newly reformed residential zones will be released in 2017 that will include requirements that will result in a mandatory percentage of garden space (rather than the current cap on the number of dwellings).

It is anticipated that the newly reformed residential zones will include requirements that blocks between 400-500 square metres require a 25% minimum garden area, blocks between 501-650 metres need 30%, and blocks larger than 650 square metres must have a 35% garden area. As the zone provisions are yet to be released however, it cannot be confirmed how these requirements will operate, where they would apply or whether there is ability for Council to vary these provisions. Changes to the residential zones are likely to have significant implications on the Urban Forest Strategy as it effects the private realm. These implications should be reviewed by the Working Group and factored into any future planning for the urban forest.

Moreland's Municipal Strategic Statement includes strategies to retain existing vegetation and large trees, provision of sufficient space and conditions for planting of new canopy and screening trees, landscape design which contributes to reduction of UHIE, summer shading and winter sun, for example:

- Application of the Moreland Landscape Guidelines 2009 to the assessment of landscape plans (Clause 21.03-4, Objective 12 and associated strategies);
- Neighbourhood Character Policy requirements include the planting of trees in front setbacks, maximise opportunities for tree planting in side and rear setbacks and if in the Neighbourhood Residential Zone, the planting of trees in the secluded private open space of each dwelling (clause 22.01) with reference to the Moreland Tree Planting Incorporated Plan for species selection (see schedules to clauses 32.07-32.09);
- Vehicle crossing provisions that limit new subdivisions to one crossover per site and therefore limit the removal of street trees and encroachment into landscaped front setbacks (see clause 22.03); and,
- Incorporated Plan Overlays, Development Plan Overlays, Design and Development Overlays that include requirements for landscaping and tree planting.

There are additional controls that provide protection for trees under Council's Planning Scheme for their botanical, habitat, ecological or environmental values. As such permit requirements exist under the following planning scheme provisions to remove, destroy or lop vegetation:

- Environmental Significance Overlays (ESO) for the Merri, Moonee Ponds, Edgars, Melville and Merlynston Creek corridors, and the suburb of Gowanbrae;
- Heritage Overlay (HO) Appendix 3
- Erosion Management Overlay (EMO) Appendix 4
- Public Acquisition Overlay (PAO) Appendix 5
- Clause 52.17 Native Vegetation

Unfortunately, existing significant vegetation outside these areas remains largely unprotected through the planning and development process.

In 2015, new requirements for landscaping and canopy trees were introduced for Neighbourhood Residential Zone. It is hoped that these provision will slow the decline of private realm canopy, but their effectiveness will need to be closely monitored through ongoing canopy analysis. It is likely that existing planning provisions for the protection of trees and encouraging tree planting will only slow the decline of private tree canopy in Moreland. It is therefore recommended that a cross Council Working Group is established to explore a range of options to strengthen greening outcomes in a strategic and coordinated manner.

New apartment developments are increasingly incorporating vegetation as a core part of design.

A range of additional mechanisms are available to Council to mitigate the declining canopy cover in the private realm and could be considered by the Working Group, including:

- Local Law;
- Maintain, improve and enforce planning protections with relevant ESO;
- A Significant Landscape Overlay;
- Additional tree controls under the HO;
- A Significant Tree Register; and
- Targeted incentive programs, and education campaigns to encourage planting in the private realm. Success in slowing the decline in private realm

PRIVATE REALM VEGETATION OPPORTUNITIES

The urban consolidation process has resulted in the loss of vegetation from the private realm. While it is very difficult to reverse this process, there are still significant opportunities in the private realm for tree canopy and vegetation.

Beyond Council street tree plantings, park plantings and waterway revegetation, there are many other ways the community can contribute to meeting the urban forest objectives, including:

- Protecting existing trees and their canopy;
- Planting canopy trees in front and backyards;
- Planting vegetation that supports biodiversity;
- Participating in community planting days;
- Provide helpful guidance on the planting of small, medium and large trees to residents;
- Tighten the protection of existing significant trees;
- Establishing green roofs and walls;
- Growing plants on balconies;
- Monitor the provision of canopy trees in line with development planning conditions;
- Providing space for canopy trees and permeable surfaces; and
- Continue to educate residents and businesses about the benefits of tree canopies.

In order to support this target, Moreland will review a range of opportunities for encouraging the protection of existing trees as well as mechanism for encouraging the planting of canopy trees in the private realm.

In addition to private residence, there are many state and private schools, hospitals and other large landholders across the municipality. Council will work with these landholders to encourage them to plant canopy trees and support the principles of Moreland's Urban Forest Strategy.

Significant Tree and Vegetation Register

The aim of a significant tree and vegetation register is to recognise, celebrate and protect exceptional or significant trees that exist in the municipality in the public and private realm, which contribute to the urban forest and city character as a whole

The City of Melbourne found that tree protection in the private realm is most effective through the creation of a significant tree register. Conditions in Moreland differ somewhat from Melbourne, but a 2012 survey identified 4,500 significant trees across the municipality. Moreland will establish a Working Group to consider the development of a significant tree and vegetation register that identifies eligible trees and vegetation for protection. There may need to be changes to the Local Law or an amendment to the Moreland Planning Scheme to complement these changes. The protection of significant trees in the private realm may be a permit trigger if any significant pruning, lopping or removal of a significant tree is proposed.

Neighbourwoods Program

In addition to tree protection measures within the local law and the planning scheme, Moreland will need to consider a range of alternative mechanisms to encourage residents to protect existing vegetation and promote the planting of canopy trees in the private realm. A Neighbourwoods programs is recommended to be trialled in Moreland to encourage greater community interest in planting appropriate canopy trees and vegetation on private land. The Neighbourwoods Program could include Council support for residential and community greening initiatives, rate rebates for greening, improved education campaigns, and the provision of free or subsidised trees. Similar programs have been running successfully in Sydney and North America for over a decade.

GREEN ROOFS

A green roof is a roof that is covered in plants, typically grown in a shallow substrate (less than 300mm). Green roofs can provide a range of environmental and social benefits, such as urban cooling, stormwater management, increased plant biodiversity, habitat for native fauna, increased amenity. The design intent should clearly state the specific outcomes or benefits that the green roof is targeting, so that the components of design can be assessed accordingly.

The 'Growing Green Guide for Melbourne' is a very useful document for designing green roofs in Melbourne and is a great place to get started. The information provided here is general in nature and technical green roof information should be obtained from design and engineering professionals to suit specific conditions.

Engineering considerations

The structural capability (weight loading) of the roof is a critical aspect of green roof design. It determines what depth of substrate the roof can hold and therefore the planting design. In Melbourne, the minimum depth of a green roof substrate should be around 100mm to aid plant survival during dry periods.

Waterproofing is important to ensure the green roof does not compromise the building. The waterproof layer should be flooded to test that there are no leaks before the green roof is installed.

Another important requirement of the design is to provide for safe access. The expected number of visitors and frequency of maintenance may affect the safety system that is installed for access and working at heights.

Plant selection

Plant selection for green roofs should consider:

- Design and functional intent of the green roof
- Substrate depth, water holding capacity and composition
- Site conditions including light levels, wind, temperature, soil moisture (both very dry and waterlogged).
- Low maintenance requirements
    - dense ground cover to outcompete weeds
    - suited to the site conditions and long lived plants or able regenerate (self seed or root suckers) so that replanting is minimised.
    - Low foliage biomass grasses are preferred to high biomass grasses as the later require considerable maintenance if the foliage browns off during dry periods.
- Ease of access to maintain the roof and the maintenance budget allocated
- Decision to apply any supplementary water after establishment

Some examples of species which may be suitable for green roofs are provided in Table 7. Species selection will be limited in shallow green roof systems (e.g 100-150mm) constructed in Melbourne and provided with no supplementary watering. To maximise survival on such green roofs, species that have high drought tolerance and yet have the capacity to be high water users should be chosen (Farrell et al. 2013; 2015). A greater range of species will be suited to green roofs with a higher water holding capacity (generally deeper substrates, for example 200-300mm). A growing number of buildings across Melbourne have green roofs that have been planted with a diversity of plants and systems.

Substrate selection

Green roof substrates should be light weight, well drained and stable over time. The University of Melbourne are evaluating a range of materials such as scoria, crushed brick, biochar and bottom ash products with organic matter added as green roof substrates.

The depth of substrate is often limited by weight loading restrictions on buildings, frequently less than 200mm when green roofs are retrofitted onto existing buildings. Light-weight materials allow the depth of substrate to be maximised within the weight loading restrictions.

It is important to consider how the substrate will be transported onto the roof. Possible methods include blowing or craning the substrate up in bags.

Maintenance

The green roof planting should be designed for low maintenance. Weeding, replanting and pruning will be required.

Fertiliser use should be minimised and only applied if the plants are showing signs of nutrient deficiency. Green roof substrates tend to have a low capacity to hold nutrients and therefore there is a risk of nutrient leaching following fertilisation. Care should be taken when applying fertiliser, particularly if the green roof runoff is connected directly to the stormwater system. If required, low doses of slow release fertilisers should be applied. Regular checks should be undertaken to ensure the drainage outlets are unblocked.

GREEN FACADES

Green facades are climbers that are grown directly on the building wall (self clinging species) or on trellis systems adjacent to the wall (stem twining species). Climbers are either grown in site soil at the base of the wall or in elevated containerised planters. Plants grown in the ground have access to a larger root zone volume and are therefore less reliant on supplementary water than containerised plantings.

Engineering considerations

The structural capability (weight loading) of the wall is important, particularly if the design includes elevated containers planters and trellis systems attached to the building. The weight loading will influence the volume of growing medium in each container.

Self-clinging climbers may affect the wall that they are growing on.

An irrigation system should be designed for elevated containerised plantings to supply supplementary water.

Plant selection and plant supply

- High foliage density down to the base of the plant if screening is required
- Capable of growing to the necessary height
- Ease of access to maintain the green façade (primarily pruning) and the maintenance budget allocated
- Plant stock should:
    - have extensive lateral branching and basal shoots
    - be acclimatized to low light intensity may be important if the climbers are to be planted in in shaded areas (Rayner et al YEAR).

Growing media selection

If the green façade planting is required to cover low building heights, climbers can be preferably planted in the on-site soil.

A light-weight and well drained growing media should be used for the containerised plantings. The composition of the media will depend on the depth and volume of the containers. There are a growing number of examples of green façade systems being installed across Melbourne. It is worth considering both the successful and failed systems.

Maintenance

The maintenance required will generally involve regular pruning of the climbers.

GREENS WALLS

Outdoor green walls are plants growing in a support system that is attached to building wall and includes a waterproof membrane. These vertical gardens can be either modular or felt based system. Frequent supplementary water is required to support the green wall and is delivered by capillary action or drip irrigation.

In general, green walls are a less preferred element of green infrastructure in Moreland, due to the higher potential risk of failure of the entire planting. To ensure success, very careful specification and installation combined with high maintenance inputs are required for outdoor green walls.

Table 7. Preferred Plants for Moreland Green Façades and Roofs

Botanical Name	Common Name	Height	Width	Native or exotic	Comment	
CLIMBERS						
Kennedia rubicunda	Dusky Coral Pea	6m	6m	Native	Stem-twiner	Green façade
Aphanopetalum resinosum	Gum Vine	1-2m	1-1.5m	Native	Stem-twiner	Green facade
Pandorea pandorana					Stem-twiner	Green facade
Kennedia nigricans					Stem-twiner	Green facade
Parthenocissus tricuspidata					Self clinging	Green facade
Ficus pumila					Self clinging	Green facade
VARIOUS						
Veronica gracilis						Green roofs
Podolepis jaceoides						Green roofs
Dianella revoluta						Green roofs
Dianella longifolia						Green roofs
Lomandra longifolia						Green roofs
Stylidium graminifolium var graminifolium						Green roofs
Pelargonium rodneyanum						Green roofs
Calocephalus citreus						Green roofs
Wahlenbergia communis						Green roofs
Wahlenbergia stricta						Green roofs
Stypandra glauca	Nodding Blue Lily	0.6m	1m	Native		Green roofs
Vittadinia cuneata var. cuneata	Woolly New Holland Daisy	0.2m	0.3m	Native		Green roofs
GRASSES						
Austrostipa scabra	Rough Spear-grass	0.4m	0.3m	Native		Green roofs
Deyeuxia quadriseta	Reed Bent-grass	0.2m (1m flowering stems)	0.4m	Native		Green roofs
Dichelachne crinita	Long-hair Plume Grass	0.5m	0.2m	Native		Green roofs
SUCCULENTS						

Lampranthus deltoides (syn. Oscularia deltoides)	Pink Iceplant	0.3m	0.8m	Exotic	Green roofs
Sedum xrubrotinctum	Jelly Bean Plant	0.2m	0.4m	Exotic	Green roofs
Sedum pachyphyllum	Jelly Beans	0.3m	0.6m	Exotic	Green roofs
Sedum spurium	Caucasian Stonecrop	0.2m	0.3m	Exotic	Green roofs
Senecio talinoides subsp. mandraliscae	Blue Chalksticks	0.3m	1m	Exotic	Green roofs
Sempervivum tectorum	Common Houseleek	0.05m	0.05m	exotic	Green roofs
Aloe hybrids					Green roofs
Echeveria hybrids					Green roofs

PRODUCTIVE TREES

Productive street trees refer to trees that are planted along streets and in parks and produce fruit or nuts which can be picked eaten and shared by the public. Traditionally, Council have been nervous about encouraging the planting of productive trees in streets and parks because of potential risk arising from fruit litter such as slip hazards and poor pest and pathogen management. A large number of residents have already planted productive trees in front of their homes. While Council would prefer to ensure all street trees are planted in an appropriate and safe manner, there is significant value in retaining existing productive trees and exploring opportunities for new plantings in streets and parks where appropriate. The safe planting of productive trees should focus on wide nature strips or in parks. Productive tree plantings by residents should be authorised by Council and subject to a safety audit.

Productive trees can supplement urban fresh food production. Council supports increasing fruit and vegetable intake, normalising the growing of food while educating the community about growing food, encouraging people to grow their own food, as well as sharing and celebrating food.

Productive street trees can provide cities and towns with a range of social, economic and environmental benefits such as building equitable food access, increased opportunities for social engagement and connection to nature, and decreasing 'food miles'. This Strategy recommends a more open approach to productive trees and encourages discussion around the issue through the public consultation stage.

COMMUNITY GARDENS

Moreland has a strong food growing heritage and a community that is increasingly interested in growing food together. Many areas along our creeks and waterways were used for growing fresh vegetables and fruit as market gardens for over a century. A community garden is land gardened by a group. Some have individual plots and others are shared spaces.

Today, CERES and Harding Street are two remaining market gardens, but Moreland has several successful community gardens including Brunswick West Community Garden, Merri Corner and Mulberry Garden.

Community gardens are increasingly popular across Moreland possibly due to our desire to reconnect with food, nature and community, but also due to declining or disappearing backyards.

Community gardens are set up and run by a wide range of people across Moreland, with varying organisational designs and objectives, involve individual or communal plots, engage a wide range of knowledge from beginners to experts, and the levels of involvement differs significantly.

While the motivations for people becoming involved in community gardens varies, it is a great way to get to meet new people, help each other and share knowledge about gardening. Community gardens are great social binders in our community even when people are not particularly driven by social motivations for getting involved.

Merri Corner Community Garden, Brunswick

11. AN OPTIMAL TREE PLANTING SCENARIO

Significant increases in environmental benefits can be achieved by selecting a larger or "optimal" tree species for a site based upon site restrictions (i.e. power lines, nature strip width, underground services) and the potential environmental benefits desired (i.e. summer shade, winter solar access, pollution removal). Each current, vacant and potential planting site in Moreland City Council has been assessed, and its site restrictions catalogued within the Moreland Street Tree Program 2016 Sites Data. For each site, an optimal tree species or tree size has been recommended, and the forecast value shown above reflects the value that each vacant site would attain once each planted tree has matured in 2050.

Under a tree canopy saturation scenario, Moreland's street trees alone could potential provide at least 14% canopy cover of the municipality or 75% streetscape canopy. Reaching 100% tree canopy saturation of Moreland's streetscapes would, however, be a very difficult goal to implement. This street tree plan reveals that Council could easily double and then more than quadruple Moreland's street tree canopy from the current 2.4% cover to 4.8% and then reach around 14% canopy cover from street trees alone. This would be achieved by utilising strategic tree species selection for vacant planting sites initially while gradually replacing underperforming or senescing trees.

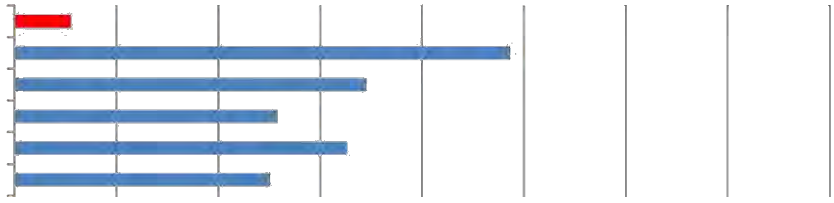
The typical and most common tree planted in Moreland's streets is from the genus Callistemon, which has an average canopy cover less than 6 m². This is 90% less than the most effective Genera Platanus and Ulmus, which have greater mature canopy dimensions. The difference in average canopy cover between these trees is clearly illustrated in Table 8.

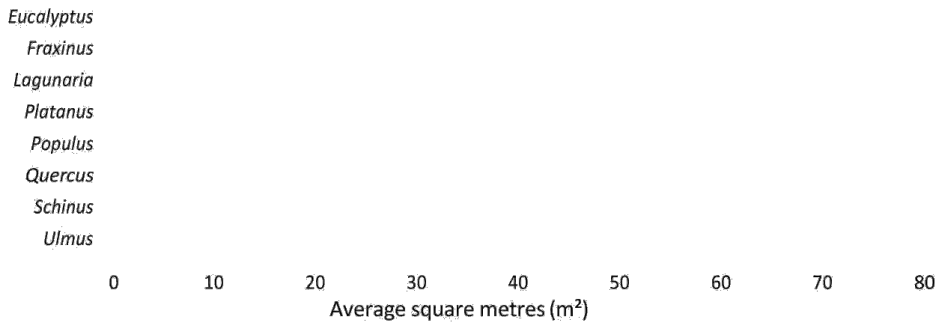
This Urban Forest Strategy proposes a dramatic change in tree selection and planting methods to ensure Council moves away from small trees (providing a minimal tree canopy) towards a medium to large tree (providing substantial canopy shade) for our streetscapes. Such a departure from business as usual will eventually require additional resource inputs to maintain the urban forest, including pruning programs, storm management and street sweeping, for example. Moreover, tree planting will be subject to site constraints. Table 8 reveals how a simple shift away from our current typical tree, the Callistemon, towards a mix of Corymbia, Eucalyptus, Quercus and Ulmus would transform Moreland's streetscapes.

Optimised planting with larger trees

- Optimised planting could attain approximately 15.6% canopy cover from street trees in 2050 by saturating (75% coverage) streetscapes without increasing the number of currently available planting sites.
- In contrast, continuing Council's current reliance on small, underperforming street trees in a business as usual approach would attain approximately 2.8% canopy cover from street trees in 2050.
- The optimised planting of larger canopy trees would increase the amenity values of street trees from $270 million to over $1.2 billion and deliver over $4.6 million in direct environmental benefits annually.
- Planting more and larger canopy trees in parks and reserves could contribute around 6% to overall tree canopy.
- Optimised planting in private property could attain approximately 40% canopy cover in 2050 with currently available private plantable spaces.
- Optimised planting of street, park and private trees could attain approximately 60% canopy cover by 2050.

Table 8. Average tree canopy cover for Moreland's top ten tree genera





Currently, species of *Callistemon*, *Lagerstroemia*, *Ligustrum*, *Pittosporum* and *Prunus* represent an estimated 35% of the current street tree population. These trees are typically small and thus represent planting sites that are underperforming. If these small underperforming trees were replaced or inter-planted with larger tree species (e.g. *Acer*, *Agonis*, *Eucalyptus*, *Gleditsia*, *Ulmus*, and *Waterhousea*), or with the largest tree suitable for the nature strip (e.g. *Eucalyptus*, *Platanus*, *Quercus)* then the environmental and amenity benefits could be significantly increased. These values take into consideration site restrictions (i.e. power lines, nature strip width, underground services) for each current and vacant site in Moreland City Council, and the forecast value shown above reflects the environmental value that would be attained once trees have matured in 2050.

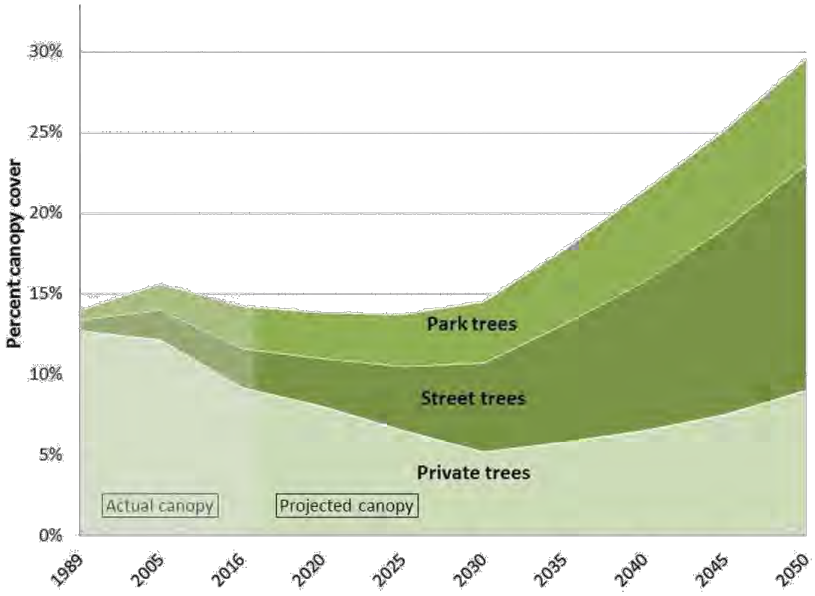


Figure 22. Actual and projected tree canopy cover under the implementation of the Urban Forest Strategy

Figure22 shows how tree canopy cover has risen and fallen during the past three decades. In 1989, Moreland had very few street and park trees which were providing only 1.3% canopy cover. The majority of canopy cover was provided for on private land with 12.7% mostly in the front and back gardens of residents (Figure 22). This figure remained rather steady over the next two decades but started to decline from 2000 with urban consolidation. By 2005, canopy cover from private trees dipped to 12.1% but dramatically dropped to 9.2% as the pace of subdivision increased. At the same time, canopy cover from street and park trees has grown strongly

from 1.9% and 1.6% respectively in 2005 to 2.4% and 2.6% by 2016 (Figure22).

Moreland's current Planning Scheme provides little protection of existing trees and vegetation in the private realm outside of areas of environmental significance. In 2016, amendments (C153) were introduced to improve vegetation outcomes in residential zones. It will be necessary to monitor the implementation of these planning requirements to understand the impact.

The initial removal of vegetation through subdivision results in the instant loss of canopy. Requirements for planting semi-mature trees can take up to 20 years to realise effective canopy. Therefore, it is likely that private realm canopy cover is going to continue declining in the short to medium term. Current vegetation protection is mostly provided in areas under an Environmental Significance Overlay (ESO) which covers much of the Merri Creek and Moonee Ponds Creek corridors. If Council adopts greater vegetation protection through amendments to the planning scheme and the local law, then it is anticipated that such measures will still take a decade to be realised in terms of canopy cover due to the lag time of new trees maturing to provide canopy cover.

This strategy recommends Council reviews the effectiveness of the current Planning Scheme and Local Law on private land to protect existing vegetation and encourage canopy tree planting. In addition, alternative programs to encourage the planting of vegetation in the private realm should be considered. A working group should be established to consider the scope and costings of any such protection measures and processes to ensure an effective and equitable approach is adopted.

Table 9. Current and 2050 canopy cover projections under optimised saturation and more realistic scenarios

Table 9 provides an optimised saturation canopy scenario which refers to the planting of medium to large canopy trees on all identified plantable land in both the public and private realm. Under this "Optimised planting" scenario, over 45% of Moreland could be covered by tree canopy. It is unlikely that this scenario is to be realised due to the current pattern of subdivision, competition with other services and diverse community values towards canopy trees. Instead, a more realistic canopy target is proposed that is nevertheless very ambitious and without changes to Moreland's planning scheme and local law remains aspirational.

53

Under this ambitious, and yet more realistic, tree canopy saturation scenario, by 2050 Moreland's street trees alone could potentially provide at least 14% canopy cover of the municipality or 75% streetscape canopy. This could be achieved by utilising larger tree species selection for vacant planting sites and when replacing underperforming or senescing trees. A further 6.6% tree canopy could be provided by park trees through the adoption of a park tree planting program.

By 2030, the implementation of the recommended planting programs could increase the canopy cover provided by street and park trees to 5.5% and 3.8% respectively. Because urban trees often take up to 30 years to reach a mature canopy, a more realistic 2050 goal is around 13-15% from street trees with a further 5-7% from park trees. This would be equivalent to a City of Melbourne tree canopy figure of around 50% of the public realm and could be achievable by 2050 with the maturity of the urban forest.

Figure 23 highlights the relationship between the diameter of Moreland's street trees' trunk diameter and its canopy cover contribution. The current over-reliance on small trunk diameter trees (i.e. Callistemon species) will continue to make it difficult for Moreland to increase its tree canopy. For example almost 60% of the current street tree population will be unlikely to attain a trunk diameter greater than 20 centimetres based upon their species.Trees with a trunk diameter less than 20 cm are currently only providing 12% of the current canopy cover; while trees with trunk diameters 20 cm – 60 cm are currently providing 68% of the current canopy cover within the streets of Moreland City Council. These trees are typically species of Eucalyptus, Melia and Melaleuca.

At a council level, there is potential for a further 23% of the municipality that can be planted with trees to provide additional canopy cover. However, only 9% of available plantable land is managed by Moreland City Council.

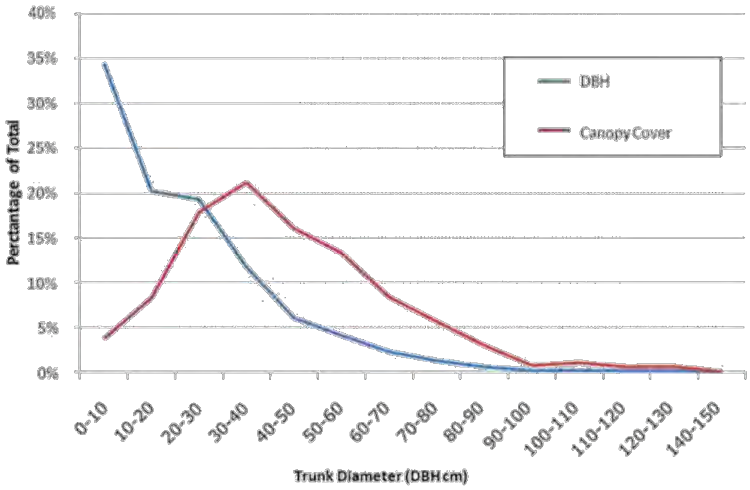


Figure 23. Relationship between the trunk diameter and canopy cover contribution of Moreland's street trees

Table 10 and Figure 24 provide a useful comparison of the benefits of shifting away from the current reliance on small trees towards medium and large trees under the optimal planting scenario.

Table 10 provides a summary of the environmental and amenity values of the current street tree population; the future street tree population with all current vacant sites filled based upon a business as usual (BAU) approach; and a future street tree population with all current vacant sites filled based upon strategic planning, and improved tree species and planting site selection. The

2050 figures in Table 10 assume a stable, saturated street tree population and mature urban forest canopy.

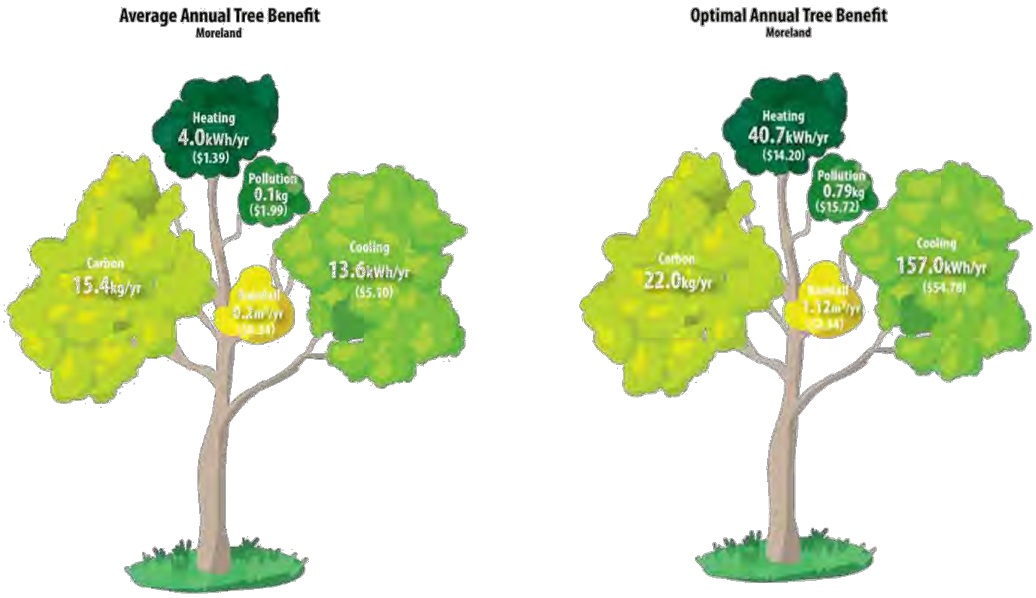
Table 10. Environmental and amenity values of current and future street trees at maturity in 2050

	Moreland Council 2016 (prior to 2016 planting season)	Moreland Council 2050 (BAU)	Moreland Optimal 2050
Estimated 2016 Street Tree Population	54,313	64,394	**64,394**
Total Canopy Cover (m^2)	813,843	1,016,355	**7,825,934**
Carbon Storage (kg)	11,328,569	14,355,034	***39,743,354***
Annual Carbon Seq. (kg/yr)	912,080	1,155,745	***1,416,530***
Amenity Value	**$271,179,839**	**$343,626,413**	***$1,222,260,806***
Annual Heating (kWh)	187,193	237,202	***2,619,742***
Annual Heating (A$)	$65,646	$83,184	***$914,290***
Annual Cooling (kWh)	784,378	993,927	***10,108,217***
Annual Cooling (A$)	$273,800	$346,946	***$3,527,767***
Annual Heating & Cooling (kWh)	971,571	1,231,129	***12,727,959***
Annual Heating & Cooling (A$)	$339,446	$430,130	***$4,442,057***
Annual Pollution (kg)	5,839.7	7,399.8	***50,870***
Annual Pollution (A$)	$2,504	$3,172	***$23,580***
Annual Avoided Runoff (m^3/yr)	8,412	10,659	***72,112***
Annual Avoided Runoff Value (A$)	$19,124	$24,233	***$163,831***
Most Common Tree	*Callistemon (22%)*	*Callistemon (22%)*	*Medium Sized Species*
Average Trunk Diameter (cm)	21.2	21.2	***30.0***
Average Height (m)	4.7	4.7	***7.0***
Average Canopy Width (m)	3.0	3.0	***6.5***

Table 10 highlights how the strategic selection of tree species can maximise the environmental and amenity benefits arising from Moreland's Streetscapes. The current amenity value of the street tree population is estimated to be worth over $271 million and would rise to over $343 million after planting all vacant sites. If improved planting methods were adopted combined with optimal tree selection to ensure medium and large canopy trees were planted instead of the current over reliance on underperforming small trees then the amenity value of the street tree population by 2050 would exceed $1.22 billion. This finding reaffirms the finding that one large healthy tree that has access to adequate soil and water is equivalent to 8 smaller trees. It highlights the need to move away from annual planting targets based upon an over reliance on small trees, simple output-based targets (such as 5,000 trees), and instead focus on quality outcomes such as net gain, canopy cover and improved urban forest health and diversity.

The amenity value of the typical street tree would rise from the current $5,000 to $19,000. Figure 24 estimates the average annual environmental benefits of a current typical tree compared with an optimal tree, which should dominant the street tree population by 2050. The transition to an optimal tree planting program reveals significant improvements in environmental benefits such as 10 times greater heating and cooling benefits from $430,130 to $4,442,057 per annum and a 30 percent improvement in carbon sequestration. The optimal planting is based upon strategic tree selection to maximise the environmental and amenity benefits of street trees. The pathway for achieving this optimal planting outcome is discussed in more detail in Part 2 of this report.

Figure 24. Comparison of environmental benefits between the current and optimal street tree planting program



A useful way to illustrate the value of shifting towards larger trees in Moreland is by measuring the environmental benefits delivered by trees. If all currently available vacant planting sites were filled in accordance with business as usual (BAU) planting practices (i.e. small average species, health, size and location), then the annual increase of environmental benefits would be $62,197. Moreland's business as usual (BAU) approach would result in the continued population density of small tree species, restricting the potential environmental benefits that each tree site can attain.

Table 11. Estimated Environmental and Amenity Value of Vacant Sites

	Available Quantity/Value of Vacant Plantings	
Environmental and Amenity Benefits	**BAU Tree Species 2050**	**Optimal Tree Species 2050**
Missing Canopy Cover (m^2)	138,164	***1,099,652***
Carbon Storage (t)	1,951	***5,641***
Annual Carbon Sequestered (t)	157	***201.1***
Annual Pollution Removal (t)	1	***7220.4***
Annual Pollution Removal (A$)	$431	***$3,347***
Annual Cooling Benefit (kWh)	135,115	***1,434,747***
Annual Cooling Benefit (A$)	$47,164	***$500,727***
Annual Heating Benefit (kWh)	32,245	***371,843***
Annual Heating Benefit (A$)	$11,308	***$129,773***
Annual Rainfall Interception (m^3)	1,449	***10,235***
Annual Rainfall Interception (A$)	$3,294	***$23,254***
Amenity Value	$46,712,848	***$173,486,098***

Table 11 highlights the contrasting environmental and amenity values that would be added to the Moreland street tree population by 2050 by filling current vacant planting sites according to current practices (business as usual) or with a more strategic plant species. If a more strategic plant species selection was utilised (i.e. an optimal tree for each site) for these vacant sites then the

annual increase of environmental benefits would be ten times greater at $657,101.

Similar gains in tree canopy cover will result from switching from the current average small tree to a medium tree.

Figure 25. Current (pink dots) and Future (green dots) Optimal Canopy Cover Map

Figure 25 illustrate the significant tree canopy differences within the residential area of Glenroy (Postcode 3046) between the two scenarios of the current planting approach (BAU) and the optimal planting approach. By planting the largest tree species to maximise canopy benefits, Glenroy's street tree canopy cover would reach 26.7% or more than five times the current planting method (BAU) of 4.8%. The variation in canopy cover on some streets denotes the presence of powerlines and the selection of smaller canopy trees.

Table 12. Street Tree Canopy Cover Projections in 2050 as a Proportion of Land Area by Suburb

Suburbs	Current Street Tree Canopy	BAU Street Tree Canopy Cover 2050	Optimal Street Tree Canopy Cover 2050
Brunswick	1.7%	2.0%	**12.4%**
Brunswick East, Fitzroy North	2.1%	2.5%	**16.2%**
Brunswick West	1.6%	1.9%	**15.9%**
Coburg	2.5%	2.9%	**16.3%**
Coburg North	1.6%	1.9%	**10.4%**
Fawkner	1.4%	1.7%	**17.3%**
Glenroy	4.1%	4.8%	**26.7%**
Gowanbrae & Tullamarine	4.5%	5.2%	**29.3%**
Hadfield	0.7%	0.8%	**4.6%**
Oak Park	0.8%	0.9%	**5.2%**
Pascoe Vale	3.8%	4.4%	**24.7%**
Pascoe Vale South	2.3%	2.7%	**15.0%**
Moreland Council Total	2.4%	2.8%	**15.6%**

57

Table 12 provides a summary of the street tree canopy cover estimates for each suburb based upon optimal strategic plant species selection when compared to business as usual planting practices. It highlights the significant gaps between the current canopy cover and the optimal canopy cover. The figures are indicative only and need to be accepted cautiously without further detailed investigation.

As noted in Table 5, there are 6,317 vacant planting sites in nature strips across Moreland and a further 941 potential planting sites requiring design outcomes (subject to site constraints). If all vacant plantings were filled in accordance with business as usual (BAU) planting practices (i.e. average species, health, size and location), then the estimated canopy cover of the Council provided by street trees would be approximately 1-1.2m² million (2.8%) of the municipality in 2050, an increase of 0.4%.

However, if more strategic plant species selection was utilised (i.e. optimal largest tree for each site) for street trees together with existing nature strip areas, which represent 6.2% of Moreland City Council, then the maximum saturated canopy cover provided by street trees could be around 7.8m² million or 15.6% by 2050 (see Figure 22). If combined with opportunities for an additional 6.6% canopy cover in Moreland's parks and reserves, then this would bring the combined public realm canopy to 22.2%. If these projections included currently available private plantable areas (14% of Moreland's land area), and assumed that, firstly, there was no further urban consolidation and, secondly, an optimal tree could be planted, then a saturation estimate of the increase in canopy cover provided by private trees could be 30%. Therefore, the potential canopy cover that could be provided by street, park and private trees in 2050 could be greater than 50% of the total land area of Moreland City Council. While it is unlikely that these optimistic scenarios will ever eventuate in Moreland, they still provide a useful guide to what is possible.

It is more likely that canopy cover from private trees is to continue declining through the process of urban consolidation from 9% in 2016 to around 5% in 2030. It is envisaged that a rebound in private realm canopy can occur if the 2016 amendments realise the intent of greening the character of the urban environment, but this may take a decade or more to be realised. This strategy recommends ongoing monitoring of canopy cover to understand how the planning scheme and local law can better complement the introduction of incentives for tree planting together with community education to provide greater protection of existing vegetation and encourage the planting of new tree canopy. Such reforms could potentially return canopy cover from the private realm to around 9% by 2050. As shown in Figure 22, this would result in a doubling of canopy cover from 14% in 2016 to 29% in 2050. However, as noted earlier, the burden for an increasing proportion of this canopy cover falls upon Council with concomitant requirements for resourcing the maintenance and management of the urban forest.

Streetscape visualisations

Streetscape visualisations provide a very powerful tool for helping Council and the community with an opportunity to re-imagine their neighbourhoods. The following images (Figures 26 - 37) provide examples of how currently vacant streets could be transformed through the design and development of planting sites. Each streetscape visualises a different type of streetscape response that could potentially be adopted. The visualisations provide a useful conceptual design response to hopefully excite the community about what can be achieved by reimagining our streetscapes. They are not meant to represent actual planned responses for the example streets.

Figures 26 and 27 highlight how in-road planting can be incorporated into wide streets in conjunction with formal nature strip tree planting as part of traffic calming treatments. These in-road planting sites can be designed so as to accommodate a large canopy tree.

Figure 26. Chapman Avenue Glenroy in 2016

Figure 27. Visualisation of Chapman Avenue Glenroy in 2050

59

Figures 28 and 29 highlight how formal nature strip tree planting can enhance the amenity and character of current industrial areas by providing large canopy shade to an identified urban heat island hot spot without impacting upon large vehicles.

Figure 28. Dawson Street Brunswick in 2016

Figure 29. Visualisation of Dawson Street Brunswick in 2050

60

Figures 30 and 31 highlight how in-road planting can be incorporated into wides streets in conjunction with formal nature strip tree planting. These in-road planting sites can be designed so as to accommodate a large canopy tree, and used to slow and direct traffic movement within a streetscape.

Figure 30. New Road Glenroy in 2016

Figure 31. Visualisation of New Road Glenroy in 2050

61

Figures 32 and 33 highlight how footpath pavement cut-outs can be incorporated into major roadways to accommodate a large canopy tree to provide greater shade which supports pedestrians and mitigates the urban heat island.

Figure 32. Nicholson Street Brunswick in 2016

Figure 33. Visualisation of Nicholson Street Brunswick in 2050

62

Figures 34 and 35 highlight how formal nature strip tree planting and in-road plantings can be used along railway corridors. These sites could be used to significantly improve pedestrian movement to transport nodes as well as provide valuable habitat connectivity.

Figure 34. Sages Road Glenroy (Gowrie Station) in 2050

Figure 35. Visualisation of Sages Road Glenroy (Gowrie Station) in 2050

63

Figures 36 and 37 highlight how in-road planting can be incorporated into Gateway roads in conjunction with formal nature strip tree planting. These in-road planting sites can be designed so as to accommodate a large canopy tree and could be used to significantly improve the visual amenity of roadways that provide access into Moreland City Council. Tree and site selection for gateways often requires approval from VicRoads to ensure proposed designs are suitable and safe.

Figure 36. Sydney Road Fawkner in 2016

Figure 37. Visualisation of Sydney Road Fawkner in 2050

12. IMPLEMENTATION PLAN & FUNDING

Council will regularly monitor and report on progress towards the successful implementation of the Urban Forest vision through three key performance indicators (KPIs) (Table 13).

Additional actions will be adopted to ensure the successfully implementation of each of the objectives for a green Moreland. These actions, with timeframes and costings, relate to a range of Council units and are detailed in the Implementation Plan.

Figure 38 maps out the priority actions in a matrix which shows *Quick Win* action that require the least effort and/or cost but deliver the greatest benefits, such as planting larger trees and a park tree program. It also shows actions requiring higher effort/cost that provide both high benefits (planning scheme amendments to protect private realm trees) and lower benefits (business as usual and undergrounding powerlines). This matrix should assist decision makers in understanding priority actions outlined in the Implementation Plan.

Understanding the implementation priorities for the urban forest strategies

Table 13. Urban Forest Strategy key performance indicators (KPI)

Indicator	Desired outcome	Reportable measure (every four years)
Canopy cover	Double public realm canopy cover across Moreland between 2017 and 2030 by increasing public and private canopy cover	Total urban forest canopy cover in the public and private realm (by suburb, vegetation type and land use)
Health of the urban forest	A healthy and diverse urban forest	At least 85% survival of new tree plantings survive at least 3 years 90% of trees in good health Well distributed age and species diversity Number of integrated water and vegetation projects
Community satisfaction	The Moreland community are satisfied with actions taken to maintain the urban forest	Level of satisfaction with Council actions

Figure 38. Priority implementation action matrix

Figure 39. Urban Forest Strategy implementation program

	ACTION	MEASURE	TIMEFRAME Short (1-3 years); medium (4-7 years); long (8-10 years); ongoing	RESPONSIBLE UNITS (lead agency in **bold**)	COSTING
1.	**CANOPY COVER TARGETS**				
1.1.	Prioritise tree canopy protection and creation in all Council activities where reasonable	Vegetation protection; canopy cover targets; resourcing planting and maintenance	Ongoing	All Council Units; **Open Space Design and Development**	Existing base budget
1.1.1	By 2030, double Moreland's public realm urban forest canopy cover	Canopy cover target	Ongoing	**Open Space Maintenance**	Existing base budget to 2020; from 2021 require maintenance resourcing assessment
1.1.2	Double vegetation canopy cover across Moreland between 2016 and 2050 by increasing overall canopy cover to 29% including 9% from private vegetation	Aspirational canopy cover target	Ongoing	Dependent upon findings of Action 2.6	Existing base budget; post-2022 costs dependent upon maintenance resourcing assessment
1.2.	Prioritise tree planting in urban heat island hot spots such as activity centres and along the public pedestrian network and key shared path routes	Canopy cover by priority areas	Ongoing	Places; Urban Design; **Open Space Design & Development**; Open Space Maintenance; Transport; Roads	Existing base budget within Structure Plan
1.3.	Prepare and cost a tree planting program in and around parks, reserves, play spaces and pathways to provide a shady, sheltered environment	Tree shade audit of Council play spaces and shared paths; Open Space and pathways tree program	Short	**Open Space Design & Development;** Open Space Maintenance; Recreation; Strategic Transport	Existing base budget
1.4.	Fill all identified vacant tree sites with the largest feasible canopy tree	Vacant sites	Medium	**Open Space Maintenance**	Existing base budget
1.5.	Replace all sub-optimal street trees with the largest feasible canopy tree	Tree health; Average tree size	Medium; ongoing	**Open Space Maintenance**	Existing base budget

1.6.	Encourage planting in the private realm	Council to work with community, state and private schools, hospitals and other large landholders to encourage canopy tree planting	Medium; ongoing	**Open Space Design and Development**; Sustainability; MEFL	Existing base budget; Grants
2.	**VALUE THE URBAN FOREST AS A CORE ELEMENT OF OUR URBAN SPACE**				
2.1.	Ensure vegetation activities are sustainably resourced and maintained in line with best practice	External review of resourcing and maintenance report	Short; Ongoing	**Open Space Maintenance**	Existing base budget
2.2.	Maintain, resource and plan public realm trees and vegetation through Council's Asset Management System (AMS)	AMS includes urban forest assets and values; Sustainably resource tree maintenance programs to ensure trees are maintained to maximise the delivery of current and future benefits	Medium	**Assets**; IT; Finance; Open Space Maintenance	Existing base budget
2.3.	Ensure all relevant capital works projects realise quality greening outcomes that enhance urban character and amenity for current and future generations	Landscaping included in relevant CAPEX; Sign off; Quarterly meetings; Landscaping technical specifications	Medium; ongoing	**Capital Expenditure Committee**; Asset Planning; Capital Works; City Development; Places; Recreation; Urban Design; Open Space Deign & Development; Engineering Services	Existing base budget
2.4.	Ensure core Council strategies and policies (including the Planning Scheme, Structure Plans, Local Law and Urban Design Framework) protect and enhance the urban forest in both the public and private realm	Review and actions	Short	All Council Units; **Open Space Design and Development**	Existing base budget
2.4.1	Review the 2017 reformed residential zones when released to understand the 'garden area' requirements within these zones and the extent to which this will impact on other actions identified in this Strategy	Review to inform working group established under Action 2.4.3	Short	**Strategic Planning**; City Development; Open Space Design and Development	Officer time
2.4.2	Review existing Residential Landscape Guidelines 2009 to ensure all relevant development applications realise quality greening outcomes with consideration of	Amended residential landscape guidelines	Short	Construction Management Program; City Development; Strategic Planning; **City Development**; Urban Design;	Existing base budget

	adequate setbacks, soil volumes, water availability, canopy space for shade trees and landscape bond	adopted; quarterly review meetings		Open Space Deign & Development; Engineering Services; Asset Protection	
2.4.3	Establish a working group to review a range of mechanisms and actions (such as planning scheme provisions, local law, significant tree and vegetation register, educational, incentives and other) for protecting vegetation in the private realm, including cost and resourcing implications.	Working Group Review Report	Short	**Strategic Planning**; City Development; Compliance; Asset Protection, Communications; Open Space Maintenance; Open Space Design and Development; Communications	Officer time
2.4.4	Assess and review development impacts upon vegetation	Develop PD for Planning Arborist position including schedule of charges	Short	**Open Space Maintenance**	Self-funded
2.5.	Protect Council's urban forest assets	Train and authorise Open Space officers	Short	Compliance; Asset Protection; **Open Space Maintenance**; City Development	Self-funded
3.	**MAINTAIN THE HEALTH OF THE URBAN FOREST**				
3.1.	Ensure annual street and park tree plantings meet tree canopy, age and species diversity, and health targets	Live street tree database; regular audit	Short; ongoing	**Open Space Maintenance**	Existing base budget
3.1.1	Ensure at least 85% of newly planted trees survive the first three years	Annual audit	Ongoing	**Open Space Maintenance**	Existing base budget
3.1.2	100% of all plantings adopt best practice planting practices	Audit to ensure all tree plantings meet minimum tree planting guidelines	Short	**Open Space Maintenance**	Existing base budget
3.1.3	Construct an irrigated holding facility	Construct an irrigated holding facility to protect Council planting programs and adequately isolate stock so as to protect against ingress and spread of pest and disease	Short	**Open Space Maintenance**	Existing base budget
3.1.4	Ensure a minimum 90% of Moreland's urban forest is healthy	Annual audit	Ongoing	**Open Space Maintenance**	Existing base budget
3.1.5	Ensure an even age distribution of trees with no age category representing greater than 50% of the tree population	Live street tree database; regular audit	Ongoing	**Open Space Maintenance**	Existing base budget

3.1.6	Ensure tree establishment and maintenance is programmed rather than reactive	Annual audit	Ongoing	**Open Space Maintenance**	Existing base budget
3.1.7	Maintain vegetation along shared and pedestrian paths	Develop costing for vegetation inspections and actions	Short	Roads; Transport; **Open Space Maintenance**	Existing base budget
3.2.	Improve soil moisture levels and tree health				
3.2.1	Integrate tree and vegetation planting with opportunities to capture stormwater through WSUD, passive irrigation and tree canopy interception	Refer to UHIe AP action	Ongoing	**Engineering Services**; Open Space Maintenance; Transport; Open Space Design & Development; Sustainability; Urban Design; City Development; Recreation	Existing base budget
3.2.2	Review Council's WaterMap 2020 to include improved vegetation outcomes	Adoption of an open space and street tree water plan to protect vegetation health and ensure cooling outcomes	Medium	Open Space Maintenance; Open Space Design & Development; **Sustainability**	Grants; Existing base budget
3.2.3	Maximise the extent of permeable surfaces and soil volumes for all vegetation in new streetscape and open space projects to improve soil health	Consider soil volumes from Better Apartment Design Guidelines	Ongoing	Engineering Services; Open Space Maintenance; Transport; **Open Space Design & Development**; Sustainability; Urban Design; Recreation; Capital Projects	Existing base budget
3.3.	Manage impacts and remediate vegetation and soil health post-construction works	Adopted in landscape specifications. Refer to Construction Management Project	Ongoing	Engineering Services; **Open Space Maintenance**; Transport; Open Space Design & Development; Sustainability; Urban Design; City Development; Recreation; Property; Facilities; Capital Projects	Self funded
3.4.	Review tree removal process	Revised tree removal procedure	Short	City Development; Open Space Design and Development; **Open Space Maintenance**; Sustainability; Capital Projects	Self funded
3.5.	Review relevant parts of the Sustainable Sites Initiative approach for managing soil health and contaminated soil in Moreland	Workshop and roll out	Short	Strategic Planning; Engineering Services; Transport; **Open Space Design & Development**; Sustainability; Capital Projects; Risk	Existing base budget

4. PROTECT URBAN ECOLOGY					
4.1.	Strengthen and fill gaps in habitat connections between waterways and parks along streets				
4.1.1		Develop a 5 year plan to sustainably fund open space renewal and revegetation works to strengthen biodiversity corridors	Short; ongoing	Open Space Maintenance; **Open Space Design & Development**	Existing base budget; Public Reserve Fund; Grants
4.1.2		Develop, maintain and resource a comprehensive network of biodiversity corridors across Moreland	Medium	Open Space Maintenance; **Open Space Design& Development**	Based on 5 year plan to sustainably fund
4.1.3		Work with state, community and private stakeholders along habitat corridors to revegetate and restore habitat	Ongoing	Open Spaces Maintenance; **Open Space Design & Development**	Existing base budget; Public Reserve Fund; Grants
4.2.	Improve the delivery of essential ecosystem services by protecting and enhancing biodiversity and urban ecology	Ensure tree palette provides biodiversity outcomes	Ongoing	**Open Space Maintenance**; Open Space Design& Development	Existing base budget
4.2.1		Retain habitat trees in parks and waterways where appropriate	Ongoing	**Open Space Maintenance**; Open Space Design& Development	Existing base budget
4.2.2		Undertake experimental habitat pruning on mature trees in open space	Ongoing	**Open Space Maintenance**	Existing base budget
4.2.3		Training and adoption of measures to protect native flora and fauna during maintenance works	Ongoing	**Open Space Maintenance**	Existing base budget
5. MANAGE AND MITIGATE URBAN FOREST RISKS					
5.1.	Incorporate hazard abatement in to programmed and reactive tree maintenance programs including staff training	Staff training, auditing and process adoption	Short	Open Space Maintenance; **Risk**	Existing base budget

5.1.1 Ensure tree risks are managed and programmed with corrective measures undertaken in responsible timeframes	Monitor and analyse risk data to identify hot spots: locations, species – review age, planting type	Short	**Open Space Maintenance**; Assets	Existing base budget
5.1.2 Determine Council's legal maintenance responsibilities for the Urban Forest	Legal brief on Council Urban Forest maintenance responsibilities	Short	Open Space Maintenance; **Risk**	Existing base budget
5.1.3 Ensure vegetation hygiene protocols are managed to best practice (ISO1400)	Adoption of best practice hygiene vegetation protocols	Short	**Open Space Maintenance**; Assets	Existing base budget
5.1.4 Protect the heritage character of the landscape	Cost the development of a tree management program for park and streetscape heritage plantings	Short	**Open Space Maintenance**	Existing base budget
5.1.5 By 2040 ensure a diverse palette of appropriate species are planted as street trees across the municipality	Overall street tree population should not consist of: *more than 40% of one family *more than 15% of one genus *more than 5% of one species	Ongoing	**Open Space Maintenance**	Existing base budget
5.1.6 Adopt and implement transparent tree risk assessment procedures	Adoption and training	Short	**Open Space Maintenance**; Risk	Existing base budget
5.1.7 Drought response	Review current drought management processes and adopt management plan	Short	**Open Space Maintenance**	Existing base budget
5.1.8 Refine current storm management response process	Revised storm management response process	Medium	**Open Space Maintenance**	Existing base budget
5.1.9 Respond to and manage current and emerging pest and pathogen issues	Pest and pathogen management process adopted	Short; Ongoing	**Open Space Maintenance**	Existing base budget

5.2.	Produce a series of urban forest decision making process flow charts to make the process clear	Urban forest decision making process flow charts	Short	**Open Space Maintenance**; Open Space Design& Development	Existing base budget
5.3.	Ensure Urban Forest Strategy reference documents remain accurate, relevant and best practice	Review Urban Forest Strategy Reference Documents	Every 5 years	**Open Space Maintenance**; Open Space Design& Development	Existing base budget
5.4.	Review the plant palette to ensure appropriate species are planted given the constraints of urban soils, adjoining assets, climate change and the management of pest and disease threats	Reviewed plant palette	Ongoing	**Open Space Maintenance**; Open Space Design& Development	Existing base budget
5.5.	Undertake a performance based risk monitoring research project	Analyse 5-10 years of after-hours call out data, insurance claims, tree assessments and customer service requests and applying them against spatial intelligence and tree species so as to conclude where your greatest risk tree populations are, and, evaluate the performance of select groups of tree/species or the entire tree population to evaluate specific maintenance programs. Data source: tree inventory data set	Medium	Open Space Maintenance; **Open Space Design& Development**; Academic researchers	External research funding
6.	**MONITOR AND REVIEW PROGRESS TO MEASURE SUCCESS AGAINST BEST PRACTICE**				
6.1.	Establish an effective review process of the implementation of the Urban Forest Strategy with resourcing implications	Establish Working Group to produce implementation progress report and resourcing gap analysis every 3 years	Ongoing	**Open Space Maintenance; Open Space Design & Development**	Existing base budget
6.2.	Monitor and review tree planting practices to ensure they are aligned with best practice and the emerging evidence base	Monitor and report every 4 years	Ongoing	**Open Space Maintenance;** Open Space Design & Development	Existing base budget

6.3.	Monitor and review tree fatalities and removals to understand symptoms and causes	Monitor and report every 4 years	Ongoing	**Open Space Maintenance;** Open Space Design & Development	Existing base budget
6.4.	Monitor and report on urban forest canopy cover change and delivery of environmental, social and economic services from the urban forest	Every 4 years monitor and report on changes by type, land use and suburb and include sample iTree Eco analysis	Ongoing	**Open Space Maintenance**	Existing base budget
6.5.	Undertake baseline and regular community biodiversity surveys	Participate in regular academic and community baseline and ongoing biodiversity surveys	Ongoing	**Open Space Maintenance**; Open Space Design& Development	Existing base budget; external grant funding
6.6.	Research, trial and monitor performance of tree species and review palette	Introduce at least one new trial species annually	Ongoing (report every 4 years)	**Open Space Maintenance**; Open Space Design& Development	Existing base budget; external grant funding
6.7.	Ensure Council officer qualifications remain current and best practice with access to relevant education, training and professional development opportunities	Leave and funding support for urban forest professional development and training	Ongoing	All Council units; **Open Space Maintenance**	Existing base budget
6.8.	Actively participate in industry and academic urban forest research projects and collaborations	Ongoing participation in research projects Staff membership of, participation in, and presentations to industry and academic events	Ongoing	**Open Space Maintenance; Open Space Design& Development**	Existing base budget
7.	**STRENGTHEN COMMUNITY CUSTODIANSHIP AND ENGAGEMENT OF THE URBAN FOREST**				
7.1.	Improve community satisfaction with Council's urban forest activities	Included in Council's annual satisfaction surveys	Short; Ongoing	Governance; **Communication**	Offcier time
7.2.	Produce a summary Urban Forest Strategy document	Summary Urban Forest Strategy	Short	Open Space Design& Development; **Communication**	Existing base budget
7.3.	Ensure urban forest database, processes and reports are live and publically accessible online (individual tree species, overlay species and dominant species)	Online urban forest platform	Medium	**IT**; Open Space Maintenance; Communication	Existing base budget

7.4.	Strengthen Moreland's acknowledgement of its traditional urban forest custodians, the Wurundjeri			**Social Policy**	
7.4.1	Protect past, present and future Wurundjeri sites of significance	AAV mapping; CHMP database; add new sites	Ongoing	IT; **Social Policy**; Open Space Design & Development; Communications	Existing base budget
7.4.2	Improve interpretative communication of Moreland's indigenous heritage	Scope a Wurundjeri atlas of Moreland that combines the cultural stories of the Wurundjeri people with the biophysical (forest cover, geology, wildlife, plants)	Ongoing	IT; **Social Policy**; Open Space Design & Development; Communications	Existing base budget
7.4.3	Prioritise the engagement of indigenous staff and consultants in vegetation planning and management	Explore funding opportunities for the development and support of new and existing indigenous training programs	Medium	Open Space; **Social Policy**; MCMC	External grant program
7.4.4	Adopt traditional land management practices in the management of vegetation	Review of natural resource management land practices for waterways and grasslands	Short	**Open Space Maintenance**; **Open Space Design& Development**; Social Policy; MCMC	Existing base budget; External grants
7.5.	Increase community opportunities to engage and connect with the urban forest	Organise events; update website	Short	IT; **Communications**; Open Space Maintenance	Existing base budget
7.5.1		Review Open Space engagement and contribution to Advisory Committee	Short	**Governance**; **Open Space Maintenance**; Open Space Design& Development	Existing base budget
7.5.2		Request a street tree program	Short	IT; Communications; **Open Space Maintenance**; Open Space Design& Development	Existing base budget
7.5.3		Scope community notification processes	Short	Open Space Design & Development; **Open Space Maintenance;** Communications	Existing base budget
7.5.4		Community planting events Support for community greening activities Funding for community greening	Ongoing (report every 4 years)	**Open Space Design & Development**; Open Space Maintenance; Sustainability; Communications; MEFL;	Existing base budget

7.5.5 Encourage neighbourhood nature strip plantings	Revised nature strip guidelines Area of beautified nature strips	Short (report every 4 years)	**Open Space Design & Development**	Existing base budget
7.5.6 Review Council process for resident requests for nature strips	Developed process for nature strip requests including scope, costings and responsibility; Pilot project	Medium	**Open Space Design & Development**; Roads; Asset protection; Open Space Maintenance	Existing base budget
7.5.7 Neighbourhood nature strip risk assessment	Scope audit of neighbourhood nature strips	Medium	**Open Space Design & Development**	Existing base budget
7.5.8 Targeted tree planting in the private realm	Trial a NeighbourWoods program	Short-Medium	**Open Space Design & Development**; Open Space Maintenance	Existing base budget; external grant
7.5.9 Business sponsorship of community planting and street trees	Review introduction of business sponsorship program and activities	Short-Medium	**Economic Development**; Places; Urban Design; Open Space Design & Development	Existing base budget

13. RELATIONSHIP TO KEY COUNCIL STRATEGIES AND POLICIES

This Urban Forest Strategy builds upon and complements current and former Council plans and policies, notably the Council Plan, 2025 Community Vision, the Street Landscape Strategy, the Municipal Strategic Statement, Structure Plans, the Health and Well Being Plan, Pedestrian Strategy, WaterMap 2020, Open Space Strategy, Moreland Play Strategy, Zero Carbon Evolution Strategy and the Urban Heat Island Effect Action Plan.

These key council strategies and policies are described below. Figure 39 shows the relationship between the Urban Forest Strategy and other key council policies and strategies.

2012 Moreland Street Landscape Strategy

The 2012 Moreland Street Landscape Strategy (MSLS) is the foundation document for the Urban Forest Strategy. It has guided Council and residents about the management and planting of street trees. This Urban Forest Strategy broadens out and builds upon the strong basis of the MSLS.

The MSLS argued that integral to successful implementation of strategy is planting the maximum number of the largest trees possible within the constraints of available space and existing infrastructure. The preference is areas that are easy to plant and have adequate available space for larger sized trees first. Where existing street infrastructure or space does not allow a tree to be grown satisfactorily in the nature strip or footpath it is recommended to consider planting trees in the parking lane or in the centre of the road. The strategy noted that these planting approaches will be extensively used within the southern areas of the Moreland City Council, in shopping centres and along main roads.

2025 Community Vision

The Moreland 2025 Community Vision sets out the vision in which our community hopes to live, work and play in the near future. The Community Vision is the first step towards aligning the activities, decisions, plans and strategies of those who shape the city - the many community groups and organisations, individuals, service providers, Council and other levels of government.

The Community Vision identified 26 desired outcomes for the municipality, 11 of which guide the Urban Forest Strategy. These are:

- Moreland community members are mentally and physically healthy, and active;
- The Moreland community feels safe and is safe;
- People have access to local places and open spaces;
- Attractive, clean and well maintained built environment, streetscapes and landscapes;
- The historical places of Moreland continue to be enhanced;
- The Moreland community is water and energy efficient;
- Moreland community is environmentally aware and active;
- Moreland's natural environment is preserved and enhanced;
- Partnerships are used to deliver community outcomes;
- The Moreland community participates in decision making; and,
- Moreland is financially responsible taking account current and future needs.

Council Plan

Following elections in late 2016, a new Council Plan (2017-2021) is to be developed providing a comprehensive overview of Council's values, commitments and activities. It includes clear goals and objectives against which Council and its administration measures its performance.

The desired outcomes of the Council Plan reinforce the 2025 Community Vision and closely relate to the Urban Forest Strategy in terms of ensuring Moreland is safe and accessible, supports community health and wellbeing, and creates an attractive and resilient environment.

Municipal Strategic Statement

The Municipal Strategic Statement sets out the overall vision to guide future land use and development in the municipality and includes key strategic directions relating to the Urban Forest Strategy, such as the status of protecting existing vegetation and identifying space for vegetation in building setbacks in line with neighbourhood character. By exception, this Strategy includes tree canopy outcomes arising from the existing

strategic direction on urban consolidation that highlights the need for careful consideration of setbacks and tree protection in the planning scheme to reverse the steady decline in vegetation from the private realm.

Structure Plans

Moreland has three long-term structure plans for each of the Glenroy, Coburg and Brunswick activity centres. The structure plans guide Council decisions about future development on both private and public property. The current plans provide little scope and opportunity for greening and canopy trees due to site constraints, such as narrow footpaths and roads, the lack of building setbacks, requirements for building awnings and concentration of underground and above ground services, such as power, gas, sewer, communications, stormwater and water. And yet trees play a significant role in creating, reinforcing and enhancing the urban character and identity of these areas. Moreover, it is effective to prioritise heat mitigation in areas where large numbers of the public are active outdoors such as public transport interchanges, recreational spaces, outdoor shopping strips, schools, care facilities and pedestrian thoroughfares. The Structure Plans do seek to maximise opportunities for greening and canopy trees and the consequent streetscape capital works projects being rolled out in each centre do the same. Therefore, innovative greening solutions will need to be embraced to ensure they can become welcoming and liveable spaces.

Health and Well Being Plan

The Municipal Health and Well Being Plan outlines the state of community health and ways to support the vision of placing "people's health and wellbeing at the centre of all planning and decision making". The Plan will be developed to align with the Council Plan 2017-2021 and reflect community priorities identified in the Moreland Community Vision and the Moreland Human Rights Policy.

The Plan references a goal to reduce UHIE through sustainable housing design to include green walls and roofs, to provide climate education activities and improving community information on strategies in relation to climate change.

Pedestrian Strategy

Moreland's Pedestrian Strategy 2010-19 provides a vision for encouraging active and sustainable movement across the municipality. The Strategy outlines objectives and actions Council can implement to support sustainable communities and are closely related to the Urban Forest Strategy including:

- Improving the walking network,
- Improving the walking environment, and
- Promoting walking.

WaterMap 2020

Watermap 2020 sets Council's strategic direction for the sustainable management of water resources in Moreland, with the ambition for Moreland to become a "water sensitive city" – a healthy, green, productive and resilient city. The objectives of Watermap 2020 are complementary of the Urban Forest Strategy and can be extended through passive irrigation and improved WSUD design to ensure healthy canopy trees and open spaces.

Watermap 2020 references many targets to improve water usage across the municipality by 2020 including; reducing Council's potable water usage by 30%, improving sportsground irrigation efficiency to 75%, treat 11% of Council's stormwater treatments to best practice, 25% reduction in community potable water consumption and 50% of community households have a water tank installed.

Open Space Strategy

The Moreland Open Space Strategy (MOSS 2012-2020) outlines the direction for the future provision, planning, design and management of publicly owned open space that is set aside for leisure, recreation and nature conservation purposes. The main aim of the Strategy is to preserve and enhance environmental values and provide for future community needs through the provision of quality open space. The strategy refers to the critical role of the urban forest in complementing the desired outcomes of quality open space.

The MOSS highlights climate change as a key issue, specifying UHIE as a key issue moving forward. Key actions of this strategy include increasing tree canopy throughout the municipality, and developing a tree management program to manage tree health within parks. Other key strategies of the MOSS are to develop a policy for appropriate use of water on Open Space, to implement Water Sensitive Urban Design (WSUD) in Urban Planning and to encourage more sustainable planting practices.

Urban Heat Island Effect Action Plan

The Urban Heat Island Effect Action Plan identifies Council and community actions to help reduce the impacts of urban heat island effect and prepare for a hotter future. This Plan provides a strong evidence base for many actions in the Urban Forest Strategy including: expanding tree canopy cover; capturing stormwater to use in open space and raingardens; and promoting green walls and roofs.

Zero Carbon Evolution Strategy

The Zero Carbon Evolution (ZCE) Strategy (2014-2020) is a plan to reduce Moreland's carbon emissions by 22% by 2020. The Urban Forest Strategy is aligned with this strategy through the critical role of trees in capturing carbon dioxide, improving thermal comfort through shade and making our streets more attractive for active modes of transport such as walking and cycling. The ZCE Strategy also highlights vulnerable areas relating to UHIE. Key goals of this strategy include increasing canopy cover through Water Sensitive Urban Design initiatives by 35% by 2020. This is in line with Council's goal of planting 5000 trees annually.

Moreland Play Strategy

The Moreland Play Strategy (2016-2020) recommends future actions to enhance play opportunities for the community and provides a guide to the management and maintenance practices of existing play spaces, as well as identifying priorities for design, development and funding allocation for future play space developments. It is aligned with the objectives of the Urban Forest Strategy of prioritising natural shade in our parks and creating a safe and attractive environment for play.

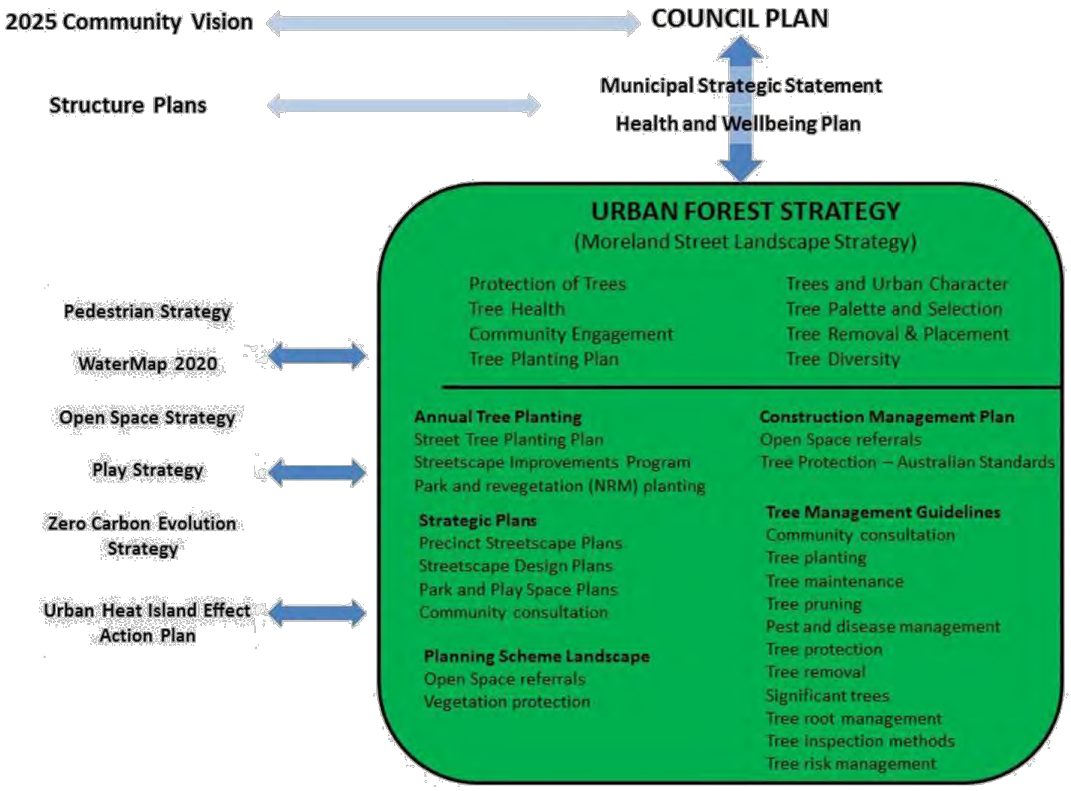


Figure 40. Relationship between Moreland's Urban Forest Strategy and other council policies and strategies

GLOSSARY

Amenity value	Amenity Value recognises a tree as a financial asset and derives a value based upon the City of Melbourne's Amenity Tree Valuation method. The valuation derives the real value of trees and recognises the amount of time and resources needed to get them to maturity in our harsh urban landscape. A value is calculated which emphasises the real value of trees and the loss of amenity for the community if the tree is removed.
Biodiversity	The variety of all life forms on earth. The different plants, animals micro-organisms and the ecosystems of which they are part.
Canopy cover	Canopy cover is often used as a proxy for measuring the contribution of trees to urban greening. In this report, canopy cover measures the physical coverage of street tree canopy over land.
Community Plan	Provides a community vision for the future of the Municipality.
Council Plan	Outlines Council directions, strategies and actions for a four year period.
Diameter at breast height (DBH)	Measures the trunk diameter at 1.4 metres above ground level
Diversity	Refers to species and age diversity to ensure a variety of species and age distribution are planted to increase the resilience of the urban forest.
Exotic tree	A plant introduced from another country or regions where it was not indigenous.
Green infrastructure	Street trees comprise a significant component of the wider urban forest (all public and private trees). These components are referred to as a city's green infrastructure. The concept of green infrastructure is based on the awareness that natural systems can perform a range of engineering, environmental and human functions. The key features of green infrastructure which distinguish it from grey infrastructure are multi-functionality and connectivity. That is, it can deliver multiple benefits from the urban space it occupies, compared with single purpose engineering infrastructure and it 'value adds' by linking and connecting existing green assets
Indigenous tree	A plant endemic to the Moreland area.
iTree Eco and iTree Canopy	Urban forest tools developed by the US Forestry Service and adapted to Australian conditions that analyse certain tree parameters to determine the environmental value of vegetation (iTree Eco) and the coverage of vegetation canopy and land-use (iTree Canopy). Combining the two tools provides accurate measures of changing environmental values of trees and the urban forest including air pollution, carbon sequestration and storage, energy saving benefits, stormwater flow reductions and an amenity value.
Liveability	An assessment of what a place is like to live in, considering environmental quality, education and health provision, access to shops and services, crime and safety, recreational facilities and cultural activities.
Municipal Strategic Statement	Sets out the council's strategic planning objectives and underpins the land-use and development provisions of the Moreland Planning Scheme.
Native tree	A plant found to occur in Australia
Nature strip	Naturestrips are the area of public land between the paved footpath (or the private property boundary where there is no footpath) and the road kerb and gutter. Nature strips provide safe

	public walkways and contribute significantly to the character of our neighbourhoods and streetscapes.
NeighbourWoods	NeighbourWoods will be a Council-led pilot program to encourage local people to plant canopy trees in the private realm. The program will include private households, and large landholders, such as schools, industrial sites and shopping centres. Activity Centres and identified Urban Heat Island Hot Spots will be a priority for the program.
Park tree	A tree planted or located within Council's open space network of parks and reserves
Private land	Refers to the following land-use classes; residential, commercial, industrial and other land-use types
Private tree	A tree planted or located on private land
Public land	Refers to the following land-use classes: Public Park, Education, Health and Community, Transport, Cemetery, Crematorium, Local Government, Conservation Zone, and other public use or service area.
Passive irrigation	Describes the integration of water cycle management into urban planning and design, such as at grade tree cut outs or raingardens.
Remnant vegetation	A plant or plants of any taxa and their progeny as part of the floristics of the recognised endemic ecological community remaining in a given location after alteration of the site or fragmentation by activities on that land or on adjacent land.
Resilience	Refers to the capacity of the urban forest to deal with major changes, such as human or natural disturbance, and continue to develop.
Significant vegetation	Vegetation with special qualities that make a contribution to biodiversity or the amenity of an area and should be protected unless they are dead, diseased, dying or dangerous. Significant trees are defined as taller than 6 metres or listed on a proposed significant tree register. Significant vegetation is listed in the Moreland Indigenous Vegetation Assessment.
Street tree	A tree planted or located within the road reserve (street, road, footpath or nature strip)
Streets	Refers to streets, roads and nature strips.
Tree	A long lived woody perennial plant, greater than three metres in height with one or relatively few main stems or trunks.
Tree health	Refers to a tree's exposure to pests and pathogens and stress and its capacity or vigour to grow, and to resist pest, disease and stress. Tree health is closely related to tree condition which includes the overall state of the tree which refers to not only health and vigour, but also structure. Tree health is measured as excellent, good, fair, poor or dead.
Tree Protection Zone (TPZ)	An area around a tree that is protected by a physical barrier from negative impacts, usually from construction activities and is measures as 12 times the DBH.
Urban forest	Refers to all trees and other vegetation in urban public and private spaces and includes, for example, street and park trees, front and backyard trees, grasslands, wetlands, nature strips, balcony plants, and green roofs and walls.
Urban Heat Island Effect	When urban areas are warmer than surrounding rural areas due to heat retention in hard surfaces such as buildings and roads. This build-up of heat is re-radiated at night time, increasing

	air temperatures which can have serious human health consequences particularly during heatwaves. The most cost effective and efficient mitigation tool is increasing tree canopy cover.
Useful life expectancy (ULE)	ULE does not refer to the biological life expectancy of a given tree species, but relates to how long a tree can be usefully retained within a given site with consideration to the trees condition, aesthetics, management inputs, and risk management.
Water sensitive urban design (WSUD)	The integration of the water cycle into urban planning and design by recognising all water streams in the urban environment as a potential resource e.g. rainwater, stormwater, grey water and blackwater. WSUD is often used to describe the infrastructure built to capture and reuse stormwater.

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REFERENCE DOCUMENTS

1. STREET TREE PLANTING PLAN
2. TREE PROTECTION GUIDE
3. MORELAND HABITAT STREETS AND BUFFER ZONES MAP
4. NATURE STRIP GUIDELINES

REFERENCE DOCUMENT 1 –STREET TREE PLANTING PLAN

The aims of the Street Tree Planting Plan are to:

1. *Improve the rate of successful establishment of street trees;*
2. *Fill currently available vacant plantings;*
3. *Prioritise tree planting in areas of low canopy cover and high urban heat island;*
4. *Systematically remove and replace underperforming (i.e. small) street trees;*
5. *Use the largest canopy, and longest lived, tree species possible for each site based upon current site restrictions;*
6. *Diversify species selection to increase resilience and lower risk from pest, disease and climate change;*
7. *Improve tree species selection based upon planting location so as to maximise the functional benefit of trees; and*
8. *Improve community understanding of, and engagement with, the urban forest.*

Sparta Place in Brunswick is a good example of converting a road into a tree lined civic space.

1. STREET TREE ISSUES AND IMPROVEMENTS

Key challenges identified as part of a review of existing Moreland City Council planting programs combined with the technical analysis include:

- Inadequate maintenance of formative tree establishment
- Inconsistencies within current tree policies and procedures
- Increased resident complaints pertaining to tree nuisance (e.g. overhanging limbs, leaf, flower and fruit litter, allergy, etc.)
- Increased residential development with a reduction in private green spaces and high impact on trees outside of Australian Standard 4970-2009
- Increased tree vandalism and poisoning
- Lack of communication materials to improve public awareness
- An over reliance on a small selection of tree species (e.g. Callistemon and Pyrus)
- Tree maintenance issues for vulnerable (aged and disabled) residents
- High incidence of root claim issues due to conflicts with Australian Standard 2870-2011
- Variability in the appreciation of trees and their value within the community
- Inefficient management procurement approval processes
- An inability for agile decision making in responding to climate variability

Key issues identified from the urban forest assessment:

- Disproportionate distribution of short tree life expectancies in some Moreland suburbs
- Variation in the amount of vacant planting sites between Moreland suburbs
- An over reliance on small tree species (e.g. Callistemon and Pyrus)
- An over reliance on tree species from the family Myrtaceae
- Reduced environmental and amenity value of street trees based on current species selections

Tree selection will take into account relative plant tolerances, adaptability and integration into surrounding planting themes, but Moreland City Council aims to plant the right tree in the right place for the right purpose.

91

Trees will therefore be selected based upon their site suitability, local character and their biological, functional and environmental benefit. Appropriate site assessment and tree selection will facilitate the following benefits:

- Improved plant performance
- Improved streetscape amenity and architectural character
- Improved urban heat island and pollution abatement
- Increased property value
- Increased tree longevity
- Mitigation of root and structure conflicts
- Reduced conflicts with private and public assets, and associated maintenance costs
- Reduction of pest, disease and weed susceptibility

Issues defining tree selection are:

- Biological requirements.
- Species adaptability.
- Maintenance frequency requirements.
- Ecological issues.
- Functional and spatial limitations.
- Environmental benefits.
- Human health considerations.
- Species longevity.
- Neighbourhood character.
- Aesthetics.
- Availability

2. PLANNING FOR MORELAND'S FUTURE URBAN FOREST: AIMING FOR QUALITY OUTCOMES

The recommendations below are based upon the assessment of the current urban forest and have been made in consideration of maximising the environmental benefits that can be provided by Moreland's urban forest.

Through the attained understanding of the state of Moreland's existing urban forest, Council will aim to:

- Increase canopy cover in available streets and parks
- Improve landscape amenity
- Increase environmental benefits of tree plantings
- Improve the health of the urban forest
- Improve biodiversity
- Improve species diversity
- Improve community engagement with trees and tree lined streetscapes
- Improve establishment rates of new tree plantings
- Improve and apply best industry practices at all times
- Maintain, improve and develop urban character
- Raise the profile of trees within Council
- Reduce the effects of urban heat island

To facilitate an improved urban forest, Moreland City Council will need to:

- Adhere and enforce relevant Australian Standards
- Improve species diversity through strategic planning
- Improve species selection to maximise environmental benefits
- Improve tree planting stock selection, planting procedures and maintenance
- Increase planting density where practicable
- Increase planting opportunities through better design
- Increase planting survival
- Maintain species provenance in native areas and streetscapes
- Optimise annual tree planting within available budgets
- Plant advanced nursery stock where practicable
- Plant all vacant planting sites
- Plant larger tree species where sites allow
- Remove and replace underperforming specimens and species
- Plan and prioritise streetscape rejuvenation projects according to needs
- Utilise water sensitive urban design principles and guidelines

To achieve these goals, and maximise the environmental and amenity benefit of the urban forest Moreland City Council will aim to:

1. Fill currently available vacant plantings
2. Prioritise tree planting in areas of low canopy cover and high urban heat island
3. Systematically remove/replace or interplant underperforming (i.e. small) street trees
4. Use the largest and longest lived tree species possible for each site based upon current site restrictions and improved design principles
5. Diversify species selection to increase resilience and lower risk from pest, disease and climate
6. Improve tree selection based upon planting locations and the maximum functional benefit of trees

A program of systematic removal and replacement, or inter-planting with more optimal species would facilitate improved amenity and environmental benefits. This recommendation would require a separate project (as yet unfunded) to be instigated, to identify and spatially locate specimens suitable for removal and replacement, and sites suitable for inter-planting.

3. CURRENT STREETSCAPE PLANTING PROGRAMS

In recent years, Moreland has had a range of tree planting programs including:

- Activity Centre Streetscape Master Plans
- Shopping Strip Renewal Program
- Main Roads & Gateways Program
- Road Reconstruction Program
- Street Tree Infill Program
- Street Landscape Improvements Program
- Principal Pedestrian Network and Pedestrian Capital Works Program

These programs aimed to provide specific street landscape programs that are tailored for local road types, uses and precincts to facilitate significant improvements in the environmental and aesthetic values of Moreland streetscapes. There have been few specific tree planting programs in Moreland's open space reserves outside the revegetation programs along the waterways and minor plantings associated with the play space renewal program.

Priority Planting Program

The Urban Forest Strategy refers to the challenge of responding to the urban heat island (UHI) through street tree canopy shade and cooling. In response to UHI, Council developed the Draft Moreland Urban Heat Island Effect Action Plan (2016). This Plan identified priority areas within the municipality for which targeted street tree planting will provide a pivotal role in reducing urban temperatures. This Action Plan is Council's long term commitment to respond to UHI, in which the following priority areas are defined:

- Priority Area 1: The North Social vulnerability - includes the suburbs of Gowanbrae, Glenroy, Hadfield and Fawkner.
- Priority Area 2: Business Activity Centres - includes the three largest Activity Centres in the municipality i.e. Coburg, Brunswick and Glenroy Business Activity Centres.
- Priority Area 3: Neighbourhood Centres - includes Neighbourhood / suburban shopping strips, schools, childcare centres and kindergartens
- Priority Area 4: Socially vulnerable (i.e. low current canopy cover)
- Priority Area 5: Major industrial areas - includes the major employment and industrial areas in Brunswick, Coburg North and Newlands.

The priority areas have been identified based upon studies conducted on their relative thermal radiation during days of extreme heat. Specific hotspots identified, that registered surface temperatures of up to 52°C, include:

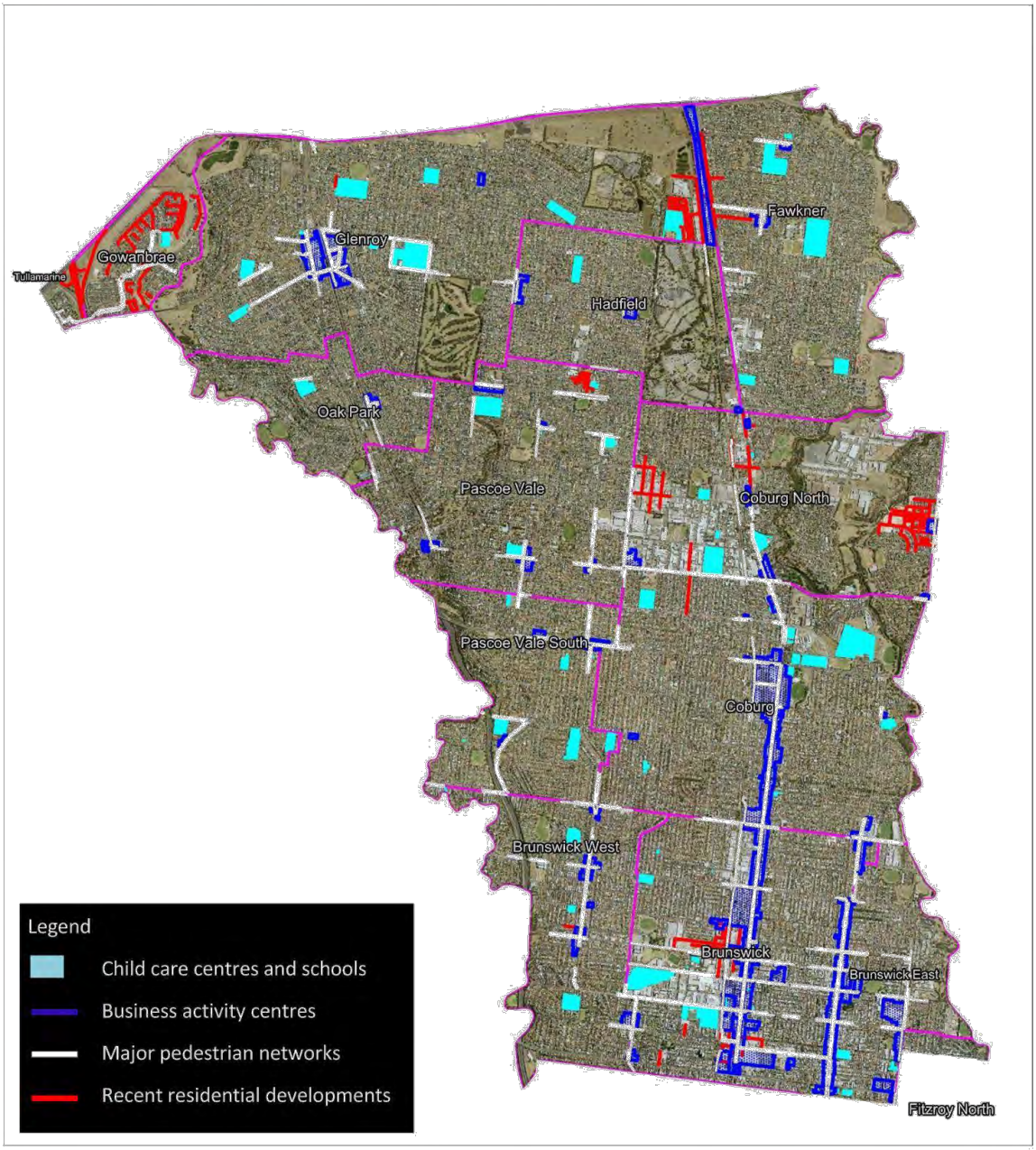
- City Link
- Western Ring Road
- Sydney Road
- Industrial and commercial areas
- Business activity centres
- Recent residential subdivisions in Gowanbrae and Coburg Hill.

By comparison irrigated and vegetated areas, such as Coburg City Oval, had surface temperatures measured at 38ºC on the same day. Trees are the most effective, cheapest and immediate method of reducing these extreme temperatures.

Figure 41 identifies a range of hotspot locations of greater social vulnerability, high commercial and residential activity, and future zoning and population increase centres. With appropriate planning and intervention these areas can attain tangible reductions in radiant urban heat and significant increases in social, environmental and economic benefits. Suitable tree selection can provide the most effective solution for cooling Moreland's hot spots. However, any tree shade solution will take at least a decade to take effect.

In conjunction with current canopy cover analysis; these hot spot areas will guide street tree planting priorities for Council. Based on the findings of this canopy analysis, Moreland needs to introduce a new park tree planting program and improve its street tree program. Subject to additional funding and budgetary commitments for park planting, the aims of the Urban Forest Strategy are unlikely to be fulfilled. Within base budgetary constraints a prioritised street tree planting program has been developed for all available and future street tree planting sites within Moreland. Each current vacant site has been allocated a priority for planting, and each current tree site has been classified into a UHI priority zone. Details of the planting site priorities are provided within: Moreland Street Tree Program 2016 Sites Data.

Figure 41. Moreland City Council heat vulnerability and UHI priority areas



96

Table 14 and15 provide a summary of the recommended street tree plantings according to the UHI priorities areas. It shows there are a significant number of vacant sites in the north of the municipality as well as in industrial areas. Almost half of the design plantings are also located in the industrial areas that overlap with the three Activity Centres of Brunswick, Coburg and Glenroy.

Table 14. Urban Heat Island priority areas for street tree planting in Moreland

UHI Priority Area	Total Tree Sites	Status	Number of Sites
Priority Area 1	20,717	Existing tree	16,766
The North Social		Potential design sites	92
Vulnerability Area		Vacant sites	3,859
Priority Area 2	3,145	Existing tree	2,553
Business Activity Centres		Potential design sites	194
		Vacant sites	398
Priority Area 3	4,291	Existing tree	3,621
Neighbourhood,		Potential design sites	120
Educational & Shopping		Vacant sites	550
Centres			
Priority Area 4	903	Existing tree	755
Low Canopy Cover		Potential design sites	43
		Vacant sites	105
Priority Area 5	35,338	Existing tree	30,618
Major Industrial Areas		Potential design sites	492
		Vacant sites	4,228
Moreland	64,394		

Numerous streets within Moreland City Council currently do not contain tree planting sites; contain irregularly spaced planting sites with no consistent streetscape layout; or could accommodate additional planting locations to facilitate incorporation of larger tree canopy species. During the 2016 street audit 941 potential plantings sites were identified. Identification of these sites was conservative; only sites that currently have irregularly spaced in road/pavement planting sites, nature strips too narrow to accommodate a large canopy tree or street widths suitable for in road planting were included. Thus, it is acknowledged that further opportunities for potential planting sites may exist within Moreland City Council, for which inclusion of street trees could significantly improve their amenity, property and environmental value. These potential planting sites represent locations that require alternative planting treatments such as in-road planting, footpath cut-outs and borrowed streetscapes such as park frontages. Planting within these sites will require detailed site planning and design, and require capital expenditure additional to the annual street tree planting program.

Table 15 provides a summary of the proposed potential plantings sites identified within each priority area. These are likely to be integrated with the annual streetscape improvements program and result in around 100 additional plantings in each of the priority areas. This list of streets will need to be prioritised in line with capital works programs and other Council priorities.

Table 15. Urban heat island priority plantings in vacant sites requiring a designed outcome

Planting Priority	Priority Area	Proposed
1	*Educational Areas & North Social Vulnerability Area*	208
2	*Business Activity Centres*	169
3	*Neighbourhood & Shopping Centres*	29
4	*Low Canopy Cover*	43
5	*Major Industrial Areas*	492

97

Site priorities

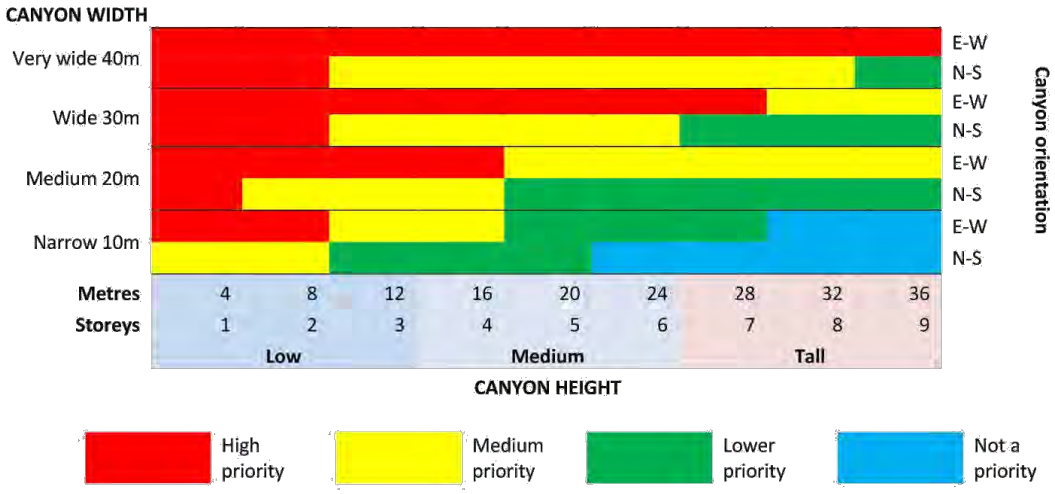
Street width, building heights and the orientation of the street shape opportunities and priorities for maximising shade and cooling benefits. Figure 42 highlights the priority streetscapes for street trees to "mitigate daytime surface temperatures based on the extent of self-shading by buildings" (Norton *et al.* 2015, 131).

Wide east west streets with low adjoining building heights are the highest priority with narrow north south streets with adjoining 5 storey buildings of lower priority due to their varying solar exposure and resulting high temperatures. Figure 42 uses street canyon ratios or road width to building height ratios as a proxy measure together with canyon orientation. Higher priority streets had a height to width ratio less than 0.8, while ratios above this reduced the benefits of trees for cooling through shade. For simplicity, the ratios have been removed and replaced with colours. The critical conclusion of the approach is that the shading benefits from canopy planting are a higher priority in east-west streets with lower canyon heights. Figure 42 illustrates how this approach could be applied in a range of streetscapes with varying canyon heights and widths as well as constraints such as overhead powerlines.

To illustrate this on the ground, both Weston Street and Sydney Road are around 20m wide and framed by two storey buildings. Weston Street would be categorised as a high priority while Sydney Road would be a medium priority due to their different orientation. A key outcome for Moreland is the importance of greening the east west streets adjoining activity centres, such on either side of Sydney Road, Lygon Street, Nicholson Road and Pascoe Vale Road. Many of these streets currently lack adequate tree canopy. Another finding from this approach is the priority need to improve shade provision from tree canopy in east west streets in areas with wide roads, such as Brunswick West.

These findings do not however preclude other important benefits that trees provide in our streetscapes.

Figure 42. Prioritising street tree shading according to the street canyon ratio of height to width (Norton *et al.* 2015)



4. TREE SELECTION

Planting the right tree in the right spot will be the general philosophy behind trees species selection. This will be done with a focus on achieving the best possible outcome in terms of providing a long lived and large canopied urban forest for the Moreland community. Moreland's tree palette includes:

- Indigenous species – trees which grow naturally in Moreland;
- Native – trees which grow naturally in Australia; and
- Exotic – trees from countries other than Australia.

Council supports using indigenous and native trees in street plantings while recognising that a broader palette of species is required to ensure a functional, diverse and successful urban forest is achieved. At the same time, Council will continue to research and trial new tree species that are suitable for Moreland's current and future environment.

In selecting the right tree for the right location, consideration will be given to:

- The existing character of neighbourhoods and streets
- Heritage values
- Functional requirements such as shade, winter light, space, sight lines and services

Indigenous trees will be planted as street trees, particularly within the creek buffers and the habitat corridors (Reference Document 3). It should be noted that some of the habitat corridors overlap with heritage areas with existing street character and that these should be preserved (Reference Document 3).

The Moreland Street Tree Species List 2017 (Reference Document 1) provides a palette of suitable tree species that Council use within their streetscapes. These trees have been especially selected due to their ability to perform well in the tough urban environment. The species listed are not exhaustive, and will be reviewed and modified as required. The trees listed have been deemed suitable for use within streetscapes and generally meet the following primary objectives:

- Can be maintained within an urban landscape for a minimum of 50 years
- Have few issues pertaining to their growth and habit
- Are tolerant of environmental stresses
- Have low pest and disease susceptibility
- Have capacity to adapt to changes in local climate

Each species within the full species list has been rated according to its environmental value, ecological benefits, pest and disease susceptibility, climate change adaptability, life expectancy, allergy potential and amenity value.

The trees listed in Table 16 represent the highest rated tree species that can provide the best environmental, ecological and amenity benefits at maturity within Moreland.

Table 16. Highest rated tree species based upon all attributes

GENUS	SPECIES	COMMON NAME	STAR RATING
Angophora	***costata***	Smooth Barked Apple	★★★★
Araucaria	***cunninghamii***	Hoop Pine	★★★★★
Araucaria	***heterophylla***	Norfolk Island Pine	★★★★★
Banksia	***integrifolia***	Coastal Banksia	★★★★
Brachychiton	***acerifolius***	Flame Tree	★★★★
Brachychiton	***populneus***	Kurrajong	★★★★
Casuarina	***cunninghamiana***	River Sheoak	★★★★
Cedrus	***atlantica***	Atlantic Cedar	★★★★
Corymbia	***citriodora***	Lemon Scented Gum	★★★★
Corymbia	***ficifolia***	Red Flowering Gum	★★★★
Corymbia	***maculata***	Spotted Gum	★★★★
Eucalyptus	***camaldulensis***	River Red Gum	★★★★
Eucalyptus	***leucoxylon cv***	Yellow Box	★★★★
Eucalyptus	***mannifera***	Brittle Gum	★★★★
Eucalyptus	***melliodora***	Yellow Box	★★★★
Eucalyptus	***scoparia***	Wallangarra Gum	★★★★

Eucalyptus	***sideroxylon***	Ironbark	★★★★
Eucalyptus	***tricarpa***	Red Ironbark	★★★★
Grevillea	***robusta***	Silky Oak	★★★★
Lophostemon	***confertus***	Queensland Brush Box	★★★★
Melaleuca	***linariifolia***	Snow in Summer	★★★★
Melaleuca	***quinquenervia***	Broad Leaved Paperbark	★★★★
Melaleuca	***styphelioides***	Prickly Paperbark	★★★★
Melia	***Azedarach* 'Elite'**	White Cedar	★★★★
Populus	***simonii***	Chinese Poplar	★★★★
Populus	***yunnanensis***	Yunnan Poplar	★★★★
Ulmus	***x hollandica***	Dutch Elm	★★★★

5. TREE SPECIES LIST

GENUS	SPECIES	COMMON NAME	FAMILY	ORIGIN	STAR RATING	TREE SIZE
Acer	*cultivars*	Maples	Aceraceae	Exotic	★★	Medium
Agonis	*Flexuosa* cultivars	Willow Myrtle	Myrtaceae	Native	★★★★	Medium
Allocasuarina	*verticillata*	Drooping Sheoak	Casuarinaceae	Indigenous	★★★	Medium
Angophora	*costata*	Smooth Barked Apple	Myrtaceae	Native	★★★★	Large
Araucaria	*cunninghamii*	Hoop Pine	Araucariaceae	Native	★★★★★	Large
Araucaria	*heterophylla*	Norfolk Island Pine	Araucariaceae	Native	★★★★★	Large
Brachychiton	*acerifolius*	Flame Tree	Malvaceae	Native	★★★★	Medium
Brachychiton	*discolour*	Lacebark Tree	Malvaceae	Native	★★★	Medium
Brachychiton	*populneus* cv	Kurrajong	Malvaceae	Native	★★★★	Medium
Buckinghamia	*celsissima*	Ivory Curl	Proteaceae	Native	★★★	Small
Callistemon	*cultivars*	Bottlebrush	Myrtaceae	Native	★★	Small
Casuarina	*cunninghamiana*	River Sheoak	Casuarinaceae	Native	★★★★	Medium
Catalpa	*bignonioides 'Nana'*	Dwarf Indian Bean Tree	Bignoniaceae	Exotic	★★★	Small
Cedrus	*atlantica*	Atlantic Cedar	Pinaceae	Exotic	★★★★	Large
Cedrus	*deodara*	Deodar Cedar	Pinaceae	Exotic	★★★	Large
Celtis	*australis*	Nettle Tree	Cannabaceae	Exotic	★★	Medium
Celtis	*occidentalis*	Hackberry	Cannabaceae	Exotic	★★★	Medium
Cercis	*canadensis cv*	Eastern Redbud	Fabaceae	Exotic	★★★	Small
Cornus	*kousa*	Dogwood	Cornaceae	Exotic	★★★	Small
Corymbia	*citriodora*	Lemon Scented Gum	Myrtaceae	Native	★★★★	Large
Corymbia	*eximia 'Nana'*	Yellow Bloodwood	Myrtaceae	Native	★★★	Medium
Corymbia	*ficifolia*	Red Flowering Gum	Myrtaceae	Native	★★★★	Medium
Corymbia	*maculata*	Spotted Gum	Myrtaceae	Native	★★★★	Large
Elaeocarpus	*reticulatus*	Blueberry Ash	Elaeocarpaceae	Native	★★★	Medium
Eucalyptus	*camaldulensis*	River Red Gum	Myrtaceae	Indigenous	★★★★	Large
Eucalyptus	*forrestiana*	Fuchsia Gum	Myrtaceae	Native	★★★	Small
Eucalyptus	*leucoxylon cv*	Yellow Box	Myrtaceae	Native	★★★★	Medium
Eucalyptus	*mannifera*	Brittle Gum	Myrtaceae	Native	★★★★	Large
Eucalyptus	*Mannifera 'Little Spotty'*	Brittle Gum	Myrtaceae	Native	★★★★	Large
Genus	**Species**	**Common Name**	**Family**	**Origin**	**Star Rating**	**Tree Size**
Eucalyptus	*melliodora*	Yellow Box	Myrtaceae	Indigenous	★★★★	Large

Genus	Species	Common Name	Family	Origin	Star Rating	Tree Size
Eucalyptus	*pauciflora*	Snow Gum	Myrtaceae	Native	★★★	Medium
Eucalyptus	*pulchella*	White Peppermint	Myrtaceae	Native	★★★	Medium
Eucalyptus	*scoparia*	Wallangarra Gum	Myrtaceae	Native	★★★★	Large
Eucalyptus	*sideroxylon*	Ironbark	Myrtaceae	Native	★★★★	Large
Eucalyptus	*tricarpa*	Red Ironbark	Myrtaceae	Indigenous	★★★★	Large
Ficus	*microcarpa var. Hilli*	Hills Fig	Moraceae	Exotic	★★	Small
Fraxinus	*americana cv*	Ash	Oleaceae	Exotic	★★	Medium
Fraxinus	*excelsior 'Aurea'*	Golden Ash	Oleaceae	Exotic	★★	Medium
Fraxinus	*pennsylvanica*	Urbanite Green Ash	Oleaceae	Exotic	★★	Medium
Fraxinus	*raywoodii*	Claret Ash	Oleaceae	Exotic	★★	Medium
Ginkgo	*biloba*	Maidenhair Tree	Ginkgoaceae	Exotic	★★★	Medium
Gleditsia	*triacanthos* cv.	Honey Locust	Fabaceae	Exotic	★★★	Medium
Grevillea	*robusta*	Silky Oak	Proteaceae	Native	★★★★	Large
Hymenosporum	*flavum*	Native Frangipani	Pittsporaceae	Native	★★★	Medium
Jacaranda	*mimosifolia*	Jacaranda	Bignoniaceae	Exotic	★★★	Medium
Koelreuteria	*paniculata*	Golden Rain Tree	Sapindaceae	Exotic	★★★	Small
Lagerstroemia	*indica* cv	Crepe Myrtle	Lythraceae	Exotic	★★	Small
Lophostemon	*confertus*	Queensland Brush Box	Myrtaceae	Native	★★★★	Medium
Maclura	*Pomifera* Wichita	Osage Orange	Moraceae	Exotic	★★★	Medium
Melaleuca	*linariifolia*	Snow in Summer	Myrtaceae	Native	★★★★	Medium
Melaleuca	*quinquenervia*	Broad Leaved Paperbark	Myrtaceae	Native	★★★★	Large
Melaleuca	*styphelioides*	Prickly Paperbark	Myrtaceae	Native	★★★★	Medium
Melia	*Azedarach* 'Elite'	White Cedar	Meliaceae	Native	★★★★	Medium
Morus	*alba*	White Mulberry	Moraceae	Exotic	★★★	Medium
Nyssa	*sylvatica*	Black Tupelo	Nyssaceae	Exotic	★★★	Medium
Olea	*africana*	Olive	Oleaceae	Exotic	★★	Small
Parrotia	*persica*	Persian Ironwood	Hamamelidaceae	Exotic	★★★	Medium
Photinia	*cultivars*	Photinia	Rosaceae	Exotic	★★★	Small
Pistacia	*chinensis*	Chinese Pistachio	Anacardiaceae	Exotic	★★	Small
Platanus	*occidentalis*	American Sycamore	Platanaceae	Exotic	★★★	Large
Platanus	*orientalis var. digitata*	Oriental Plane	Platanaceae	Exotic	★★★	Large
Platanus	*x acerifolia*	Plane Tree	Platanaceae	Exotic	★★★	Large
Populus	*simonii*	Chinese Poplar	Salicaceae	Exotic	★★★★	Medium
Populus	*yunnanensis*	Yunnan Poplar	Salicaceae	Exotic	★★★★	Large

Prunus	*cultivars*	Flowering Plums	Rosaceae	Exotic	★★	Small
Pyrus	*calleryana cv*	Callery Pear	Rosaceae	Exotic	★★	Medium
Quercus	*canariensis*	Algerian Oak	Fagaceae	Exotic	★★★	Large
Quercus	*cerris*	Turkey Oak	Fagaceae	Exotic	★★★	Medium
Quercus	*ilex*	Holm Oak	Fagaceae	Exotic	★★★	Medium
Quercus	*palustris*	Pin Oak	Fagaceae	Exotic	★★★	Large
Quercus	*robur*	English Oak	Fagaceae	Exotic	★★★	Large
Quercus	*robur* 'Fastigata'	Fastigate English Oak	Fagaceae	Exotic	★★	Medium
Quercus	*rubra*	Red Oak	Fagaceae	Exotic	★★★	Medium
Robinia	*Pseudoacacia* cv.	Mop Top Robinia	Fabaceae	Exotic	★★	Small
Tristaniopsis	*laurina*	Watergum	Myrtaceae	Native	★★	Medium
Ulmus	*parvifolia*	Chinese Elm	Ulmaceae	Exotic	★★★	Medium
Ulmus	*x hollandica*	Dutch Elm	Ulmaceae	Exotic	★★★★	Large
Zelkova	*serrata*	Zelkova	Ulmaceae	Exotic	★★★	Medium

In addition, to this list, Council will trial several trees for performance with a focus on trees that will suit climate change with longer, drier conditions and extreme heat in summer.

* Several tree species in the list above are only suitable for WSUDs while others require wide nature strips.

The Star Rating Methodology involves a Total Environmental Benefit Rating based upon an average mature specimen i-TreeEco valuation. A comparative rating is given for each i-TreeEco valuation. Average Rating for i-TreeEco valuations is used to determine a Total Environmental Benefit. The Star Rating is based upon 6 paramters: Total Environmental Benefit + Amenity Benefit + Pest/Disease/Biosecurity + Life Expectancy + Ecology + Climate Adaptation.

- **Amenity Benefit Rating**: Comparative rating given for each i-TreeEco valuation.
- **Pest /Disease and Biosecurity Rating**: Number of Pest and disease issues and Number of potential Biosecurity issues; Rating = 5 - (Pest and diseases + Biosecurity issues); NB: Superficial Pest and disease issues discounted (e.g. scale = 0.5; Phytophthora cinnamomi = 1). Rating factors in potential specific climate change issues.
- **Ecology**: Rating = Origin + Bark type + Flowers; Origin (indigenous = 2 points; native = 1 point; exotic = 0 points); Bark (deeply fissured/fibrous = 2 point; fissured/rough/flaky = 1 point; smooth = 0 points); Flowers (abundant or large = 2 point; small or clusters = 1 point; inconspicuous or non-flowering = 0 points)
- **Life expectancy**: 1 star = <20 years; 2 stars = 20-50 years; 4 stars = 50-100 years; 5 stars = >100 year;
- **Climate adaptation ranking**: 5 stars = Drought, Flood and Humidity tolerant; 4 stars = 2 of Drought, Flood and Humidity tolerance ; 3 star = 1 of Drought, Flood and Humidity tolerance.

6. SITE SELECTION

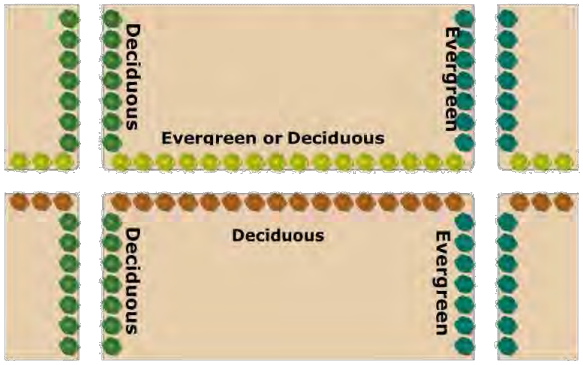
Moreland City Council will select appropriate tree species for street tree plantings based on the available planting space and local conditions. Tree species selection will take into consideration the available space for above and below ground tree growth with a fundamental design parameter of using the largest acceptable tree in each planting situation. The space available for tree planting will differ depending on aboveground and belowground services, the width of the road reserve, the usage of the road, and the setback of buildings from property boundaries. Additional local conditions that are considered include neighbourhood character, heritage and/or environmental overlays, street width, building heights and the orientation of the street.

For example, within Moreland there are important areas of remnant indigenous vegetation, identified as Habitat Streets and Buffer Zones - maps of the areas are provided in (Reference Document 3). Indigenous and native species may be preferred for planting in nominated biodiversity corridors; but maintaining existing exotic species streetscape themes is encouraged as these species can also provide vital habitat for local fauna and can represent heritage and landscape value to local communities. The critical consideration for habitat is the connectivity of canopy, which is best achieved through the use of larger canopy trees.

The next possible step is to consider tree species. Generally, a dense, thick tree canopy provides the best shade, but other questions are important to consider including: the choice between a deciduous or evergreen tree, or, are broad leaf trees better than fine needle foliage trees; and what about the height of the tree? While broad canopy trees are ideal, smaller trees may be preferable for shading pedestrian thoroughfares in summer while taller trees will provide greater shade and cooling benefits to adjoining buildings. Making such decisions often comes down to local site conditions and constraints as well as the functional traits that are desired for the character of the area. For busy retail and arterial roads such as Sydney Road, Nicholson Street and Pascoe Vale Road there are considerable existing constraints that limit the opportunities for planting trees, but sometimes breaks in the canopy and a variable canopy are desired because they provide ventilation which assists the dispersion of motor vehicle pollutants and heat. As such, figure 43 provides an idealised landscape that would maximise the passive and active benefits of street trees.

Details of each planting site, site restrictions and recommended tree species/size are provided within Reference Document 1, the *Moreland Street Tree Program 2016 Sites Database* and the *2016 Moreland Tree Species List*. The species lists have been developed in reference to existing Council documents, current species within Moreland landscapes, and tree species proven to perform in urban and poor soil environments. A snapshot of the database and the tree species list are in Reference Document 1.

Figure 43. Idealised streetscape planting to maximise passive and active benefits of street trees



Tree Size

Three basic tree size categories are defined for tree species selection, based upon the mature tree dimensions, typical mature canopy habit and root growth requirements.

The tree size categories are:

Small	Generally less than 5 metres tall and 5 metres wide Generally suitable for nature strips less than 0.5 metres wide
Medium	Generally less than 12 metres tall and 10 metres wide Generally suitable for nature strips >0.5 metres wide
Large	Greater than 15 metres tall and wide Generally suitable for nature strips greater than >1.5 metres wide

Typical mature tree dimensions are based upon available literature, current specimens within Moreland, information provided by nurseries, and typical performance of specimens in urban environments. It is acknowledged that there can be variability of mature tree dimensions due to genetic variances, environmental constraints, climatic conditions and provenance of planting stock. To account for these variances conservative estimates have been used.

Sustainable species selection

Sustainability is a critical consideration in Moreland's approach to tree selection. Several steps are important to ensuring a sustainable species is selected for each site. Moreland supports the Sustainable Sites Initiative (SITES; http://sustainablesites.org), which encourages the planting of appropriate vegetation:

- adapted to or tolerant of the site conditions
- Non-invasive; and
- Meet the design intent

SITES is a certification program for landscapes that is similar to the LEED and BREEAM programs for sustainable buildings. SITES criteria promote a range of sustainable ecosystem services, from shade and carbon sequestration to wildlife food and cover.

The first consideration for selecting the appropriate tree or plant species is to acknowledge the need to improve the existing soil conditions (see Section on urban soils). Second, we need to consider the site constraints such as services like overhead powerlines, the width of the nature strip, canopy constraints such as buildings which limit light availability and growth, safety around sight lines and setbacks and access to water. Third we need to decide what outcome we want for the landscape in terms of amenity and functionality. Functionality refers to the ecosystem services the tree will provide such as supporting biodiversity, shade provision and erosion control. Fourthly, we will prepare a list of suitable trees that meet all of the above conditions and can tolerate the site constraints.

Indigenous versus Native versus Exotic

A critical consideration for Moreland is ensuring the right tree is planted in the right place. The debate around whether Moreland plants indigenous, native or exotic trees needs to acknowledge that whatever is planted needs to be able to tolerate our harsh urban conditions.

We have fundamentally altered the growing conditions for vegetation. Across Moreland, most soils have limited top soil due to scraping and grading. Compaction of the soil in preparation of road and building construction along streets or by heavy machinery and foot traffic in open space is typical. Compaction reduces a tree roots access to oxygen, water, nutrients and growth. Buildings block light and constrain canopy growth, limiting the ability of plants to photosynthesize. Hard, impermeable surfaces, such as roads and car parks, channel water into low-lying areas, waterlogging the ground. Lime leaches from aging concrete footpaths and building foundations, raising the soil pH. Temperatures become abnormally elevated due to the absorption of solar energy by the built landscape (the so-called heat island effect). All of these typical urban factors constrain tree establishment, healthy growth and shorten the life expectancy of trees.

Our indigenous trees are well suited to pre-colonial conditions that are found in small remnant patches around the Northern Golf Course, Fawkner Memorial Park and some protected sections of our creeks, but do not necessarily suit current streetscape conditions.

Arguments for planting indigenous species often include that they require less maintenance and perform better because they have evolved over thousands of years to better suit local conditions and have developed resistance to pests, diseases, climatic extremes and other stresses of the local environment. The evidence tells us that exotics can actually perform better in disturbed urban environments.

Another argument for indigenous species is biodiversity, but we know that greater plant diversity and species can actually improve biodiversity and improve urban forest resilience to pest and diseases. Some indigenous plants however do provide critical support for specialist native flora and fauna and this is why Moreland encourages the planting of indigenous vegetation along our habitat corridors, our creeks and other waterways (Reference Document 3).

Selecting appropriate species may be indigenous, native or exotic. Regardless of where the species comes from, it must grow well under existing site conditions. *Bursaria spinosa* or *Eucalyptus leucoxylon* are indigenous trees but may be a poor choice if they do not match site requirements.

Moreland does acknowledge, however, that indigenous and native plants play an important role in our streets and parks. There is value in knowing where we are, to acknowledge a place, and celebrate that place. The legacy of a heavy reliance on indigenous and native trees already helps in this place recognition, but so too does the absence of shade and canopy trees.

7. PROPOSED STREET TREE PLANTING PROGRAM

Currently, Moreland City Council's Open Space Unit plant 5,000 street trees annually. This number was recommended within the Zero Carbon Evolution (2014) and the Moreland Urban Heat Island Effect Action Plan (2016) in an effort to reduce vacant plantings sites and mitigate the effects of UHI in Moreland City Council.

Issues identified by Council staff with the annual street tree planting program of 5,000 trees has been the increased mortality and decreased rate of establishment, and the negative community perception that occurs when newly planted trees do not survive. Recent extreme climate stresses have exacerbated annual tree loses. These issues have occurred due to insufficient resources, poor stock quality, and insufficient Council staff to water the compounding number of planted trees, and limited budget to provide ongoing aftercare maintenance of planted trees during their establishment period and when significant climate conditions occur.

Ambitious annual tree planting targets are ideal outcomes for Moreland but need to be sustainably resourced and implemented. The neighbouring municipalities around Moreland have much more modest annual tree planting targets, for example:

- Maribyrnong 1,200 annually
- Melbourne 1,500 annually
- Darebin 1,500 annually

Table 17. Annual tree planting budget, 2015-16

Annual Tree Planting Budget	Expenditure
Base Tree planting budget	$770,145
Additional Tree Budget	$150,000
Watering truck	$51,418
Core Street Tree Planting Budget	$971,563
Street Landscape Improvements Program	$100,000
Total Tree Planting Budget	**$1,071,563**

As shown in Table 17, Council invested $1,071,563 in the 2015-2016 financial year towards its street tree program. This included the baseline budget of $770,145 plus the additional $150,000 for the recent increase in planting to reach the annual 5,000 annual trees target. In addition, since 2014, $100,000 has been allocated to an annual Street Landscape Improvements Program which targets more difficult planting sites. Prior to 2014, this program was funded to $200,000 and it is likely that this funding may need to be reinstated if Council is to successfully plant up the more difficult design sites identified in the audit of vacant sites, particularly in the Activity Centres.

It is recommended that Council's Open Spaces review the cost and resourcing of the current urban forest strategy together with consideration of future resourcing requirements of a growing canopy.

Table 18. Tree Planting Establishment Costs, 2015-16

Planting costs/tree	
Location	$4.20
Stakes	$5.00
Ties	$0.30
Fertiliser	$1.00
Watering	$10.00
Mulch	$6.50
Consultation	$4.00
Service proofing	$8.00
Screenings	$8.00
Water well	$24.50
Pre-dig	$20.00
Labour (standard tree)	$18.00
Total	**$109.50**

In response to the focus on healthier trees and net gain, Table 18 provides a breakdown of the estimated tree establishment costs for an improved approach to tree planting which is detailed in Sections 28 to 31. There are some shifts in the previous approach including pre-digging and the use of water well products such as GreenWells. The wells will improve water retention and deep watering, which has been an issue in previous years with soils becoming hydrophobic during summer.

In order to improve the tree establishment and maintenance program, it is recommended that the annual street tree planting program is reduced from 5,000 to 3,500 per annum. The reduction in annual planting will allow for part of the current tree planting budget to be reallocated to maintaining a smaller number of trees which will facilitate improved watering and maintenance, which will result in a reduction in tree mortality and increased successful establishment.

To ensure the successful establishment of the reduced annual planting number annual current budgets must be maintained. Money diverted from stock purchases and

tree planting will be redirected to watering and maintenance, including mulching and formative pruning, and towards routine auditing of planting and maintenance activities, and maintaining detailed records of all tree planting projects. The budget in Table 19 illustrates the value of shifting from a tree planting program based on quantity towards a quality outcome with the proposed 3,500 annual planting program.

In line with the adjusted annual street tree planting budget and the need to remain cost neutral, the following allocation for a 3,500 annual tree planting plan is proposed:

1,400 Trees	Replacement of trees annually removed (i.e. dead, declining and development)
1,600 Trees	Current vacant plantings sites
500 Trees	Inter planting and replacement of underperforming in high visitation areas with advanced plantings
Total 3,500 annual tree planting program	

It is anticipated that at least 50 street trees will be planted annually as part of capital works program requiring site specific design outcomes. These design plantings could come out of the existing Streetscape Improvements Program and landscaping works as part of other capital works projects.

The above budget assumptions assume there will be no significant pest and disease threats or drought events that result in above average mortality rates. Unfortunately, such events are increasingly likely under climate change and require adaptive and agile management and decision making. Management will therefore need to have the capacity to adjust resourcing of planting and maintenance programs to protect existing assets for example by increasing watering programs.

Table 19. Projected current and proposed tree planting programs

	Current (BAU) Annual Tree Planting	Proposed Annual Tree Planting Plan
Annual Tree Planting	5,000	3,500
Estimated Planting Mortality (3 years)	700 (14%)	175 (5%)
Estimated Plantings Vandalised	400 (8%)	175 (5%)
Estimated Total Tree Planting Losses	1,100 (22%)	350 (10%)
Estimated Tree Planting Survival	1,100	3,150
Senescing Trees Removed Annually	1,901 (3.5%)	1,946 (3.5%)
Proposed Design Planting		<100
Annual Street Tree Net Gain	**1,999**	**1,404**

Table 19 provides a summary of the current (business as usual) annual tree planting program and the proposed annual tree planting program. The rates of mortality attributed to the current annual planting program are based upon averages during the past few years. The rates of mortality attributed to the proposed annual planting program are estimates based upon an improved maintenance program to ensure better tree establishment. Despite the lower figure of 3,500 trees, the net gain is only 595 less due to the improved survival rates under the proposed maintenance schedule.

The current number of tree losses (senescing trees) listed in Table 19 reflects trees removed as a result of age (i.e. death), declining health and development and is equivalent to around 3.5% annually of the total tree population.

Table 20 sets out Moreland's annual tree planting programs under a revised street tree planting plan. In addition to the 3,500 street tree program, Council will plant around 500 trees in our creeks and waterways and a further 50-100 trees in streets requiring a design outcome as part of the Street Landscape Improvements Program. An additional 110 to 160 trees will be planted as part of a play spaces and shade tree program. A park tree program will be considered by Council together costings and could deliver a further 500 trees annually to open spaces and reserves.

Table 20. Annual tree planting programs

Initiative	Trees planted
Street tree program	3500
NRM revegetation	600
Designed street landscape projects	50-100
Play space renewal projects	40-50
Shade tree projects	70
Total	**4,260-4,320**

As shown in Table 21, the current planting program can achieve saturation of all current vacant street tree planting sites by 2021. In contrast, saturation will be reached a year later in 2022 under the reduced 3,500 annual tree planting program. However, Table 21 highlights the current street tree planting program would need to plant 21,000 trees to achieve saturation, while the proposed street tree planting program would only need to plant 17,500 trees, resulting in project cost savings together with a healthier, larger canopy tree.

Table 21. Projected timeframes for current and proposed street tree planting programs reaching vacant site saturation by 2021

		Current (BAU) Planting Program				Proposed Planting Program		
Planting Year		**Trees Planted**	**Current (BAU) Street Trees Net Gain**	**Total street tree population**		**Trees Planted**	**Proposed (Optimal) Annual Street Tree Net Gain**	**Total street tree population**
Year	2017	5,000	2,479	59,334		3,500	1,829	58,684
Year	2018	5,000	2,417	61,750		3,500	1,783	60,467
Year	2019	5,000	2,356	64,107		3,500	1,738	62,205
Year	2020	3,500	1,127	65,234		3,500	1,695	63,900
Year	2021	2,500	319	65,553		3,500	1,972	65,872
Total trees planted		**21,000**	**8,698**			**17,500**	**9,017**	

Savings made through the reduced annual planting figures will be reinvested in improved maintenance programs. This will facilitate improved maintenance works such as:

- An annual formative pruning program
- Improved annual maintenance of mulch and planting hardware (e.g. stakes and guards)
- Improved pest and disease management
- Improved plant nutrition monitoring and management
- Increased cyclic watering programs

In addition, several additional areas of the tree planting program have been identified that require critical investments to improve the maintenance of the street tree population. Initial investments include:

- Excavation equipment for hole pre-digging
- Additional tree guards to reduce vandalism
- Purpose built watering truck to facilitate deep watering
- Larger nursery stock
- Specialist equipment (pruning tools, soil moisture meters, auditing software and hardware)
- Stock & materials storage facility with automated irrigation capacity (to accommodate a minimum of 3,500 contract grown trees, mulch, soil amendments, planting hole screenings, stakes etc.)
- Improved access to emergency procurement for materials and human resources

Additional labour (full-time & part-time)

To ensure the completion of the identified proposed potential planting sites within the same timeframe as the annual street tree planting program (i.e. 5 years), it is recommended that capital projects are identified for opportunities to plant out the 941 potential planting sites. It is recommended that landscaping works should once again be incorporated within capital works budgets rather than considered an optional extra.

The planting site designs for the potential design plantings would be conducted by the Open Space Design and Development unit of Council. Additional design outcomes for street trees will be undertaken by Council's Urban Design Unit and Places Team within the three Activity Centres and other Retail Precincts. Such projects should be undertaken in a collaborative manner to ensure opportunities are identified for tree canopy utilising water sensitive urban design principles and guidelines. All tree planting and maintenance should be conducted by Moreland City Council staff or appointed contractors.

8. NEIGHBOURHOOD PRECINCTS

Moreland City Council is responsible for approximately 622km of local roads, 1,089km of associated footpath assets and over 55km of shared user paths. Vic Roads is responsible for the maintenance of the Arterial road network but not including the footpaths and nature strips.

Although existing street trees are located in a significant number of the above road types, specific Street Landscape programs that are tailored for different road types, uses and precincts is required to ensure a dramatic improvement in the aesthetic and environmental values of street landscapes throughout the City.

ACTIVITY CENTRES & RETAIL PRECINCTS

Activity Centres provide the focus for services, employment and social interaction in cities. There are three designated Activity Centres within Moreland City Council: Coburg, Brunswick and Glenroy. Coburg, has been designated a Principal Activity Centre and Brunswick and Glenroy have been designated as Major Activity Centres.

Unfortunately, the street infrastructure and landscape presentation in many of Moreland's retail and activity centres remains constrained by competing services and demands on these spaces. And yet, thermal imaging has revealed these areas to be the hottest parts of Moreland due to the lack of vegetation and high concentration of hard surfaces.

To rectify some of these issues, Council has implemented a number of streetscape improvement projects with further ones being developed. These streetscape improvements will contribute to softening the hard built form of these areas and improve overall amenity.

Landscape upgrades have already occurred for a number of retail centres such as Major Road Fawkner, Snell Grove Oak Park, Pascoe Vale Road Glenroy and Dawson Street Brunswick which demonstrate how a considered street landscape design approach and community consultation with traders can result in a transformation and reinvigoration of these centres.

A major challenge for these areas are the spatial constraints of narrow roads and footpaths, little to no building setbacks and the large number of competing

above ground and below ground services. Design outcomes will therefore be required including planting trees in road reserves.

There are numerous benefits to planting trees in the road and away from footpaths in these areas, including:

- Easier to achieve effective canopy cover
- Reduce problems for pedestrian movement and damage
- Reduce risk of tree loss due to service access
- Improve tree health through passive irrigation
- Reduces tree canopy liabilities with overhang across private property
- Easier to prune due to less services, and
- Passively slow vehicle movements

It is intended that the Urban Forest Strategy forms a useful guide for Urban Designers and Landscape Architects to create landscapes that are more sensitive to trees and with an understanding of the requirements of designing optimal spaces for trees to grow.

Physical renewal projects for Moreland's retail centres will continue to require a reasonable level of capital funding in order to achieve the desired level of improved amenity and presentation. It is imperative that key areas of Council including Engineering, Urban Design, Transport, Places and Open Space continue to work with Economic Development to identify opportunities for the alignment of capital and operational programs to maximise the opportunity for improving these centres and appropriately resource the maintenance requirements.

MAIN ROADS AND GATEWAYS

A Main Roads and Gateways Street Tree Planting Implementation Strategy has been implemented since 2008 with a focus on developing more consistent avenues of tree plantingss for the main roads and to improve general City presentation through greening and landscape works. The Strategy identified 24 main roads and 11 gateways to the City of Moreland. Each main road and gateway was assessed in terms of existing trees, proposed tree removals, additional plantings, including appropriate species suggestions and the estimated costs involved.

By 2017, several main roads and gateways remain to be planted. Council is examining the remaining sites to assess options for tree plantings through retail precinct upgrades and alignment with significant housing developments particularly in Brunswick, Brunswick East and Coburg. In 2017 Council commenced a program to assess greening opportunities along one of the most difficult main roads, Sydney Road. It is envisaged that adjoining streets and innovative design solutions will play a central role in realising such greening outcomes.

In 2016, VicRoads introduced a revised Tree Planting Guide which provides greater opportunities for street tree planting. The ongoing roll out of reduced speed limits along many VicRoads roads allows for more significant landscaping and will be factored in to future planting programs.

PRINCIPAL PEDESTRIAN NETWORK

Enabling walking in Moreland is critical to shaping a healthy and vibrant community. Walking is the simplest, and most universally accessible form of transport available. It is free, requires no special equipment and is available to the largest section of the community.

There is an urgent need to improve community activity levels due to our largely sedentary lifestyles with 62% of Victorians overweight or obese and 1 in 4 children overweight or obese. As a result, non-communicable diseases such as diabetes are on the rise.

Street trees provide shade to pedestrians, thus making the walking environment more pleasant, attractive and comfortable. They also provide rain and skin protection, lower urban air temperatures and make streets more aesthetically pleasing. Thus street trees and landscaping are an important element in improving the walkability of a street.

Council has developed a Pedestrian Strategy that identifies key pedestrian nodes and routes across the municipality. These nodes and routes have been factored in to the priorities for the Urban Forest Strategy to ensure that areas of high pedestrian activity are prioritised to provide shade and improved amenity.

The tree planting guidelines provide helpful direction to ensure that new tree plantings enhance pedestrian movement rather than impair it by creating inaccessible footpaths, trip hazards, poor sight lines and blocking street lighting. In areas with narrow footpaths, the Urban Forest Strategy recommends either widening the footpath to cater for canopy trees or the planting of

trees in roads. This strategy attempts to balance these and other issues and highlight Council's commitment to nurturing, preserving and developing trees that promote walking.

RESDIENTIAL PRECINCTS

The Urban Forest Strategy has identified the need for residential precinct plans as a key implementation tool which should provide a framework for tree planting in Moreland streets to meet the Strategy's targets. The precinct plans would be developed in close partnership with the local community and sit under the urban forest strategy and guide the implementation of the Moreland Street Tree Plan at a local level. Moreland is divided into 8 precincts and each precinct plan would bring together distinctive neighbourhood characteristics, urban design principles and community values to determine the types of street tree plantings. The precinct plan would assist Council and the community in understanding the priority planting locations, expected works and required budget within each precinct.

Rather than designate specific species for each street, the precinct plans shall include performance based criteria in line with the desired outcomes for different streetscapes and given different physical constraints. For example, some streets would be planted using overlays from existing strategic documents such as gateways, significant streetscapes, habitat corridors (Reference Document 3) and retail precincts.

DESIGN PRINCIPLES

Prior to the development of a residential precincts plan with the community, the Urban Forest Strategy recommends a simple design approach that provides Moreland with a sustainable greening strategy without requiring design professionals to specify and locate each tree in every street, but rather provides a suggested street by street tree palette and locator given existing constraints and opportunities. The tree palette should also provide a decision making framework for Council planning and operational staff when establishing street landscapes. The fundamental design consideration to be addressed is to provide the right size tree of the most suitable species is located in the most appropriate position. A range of planting design options should exist for each street and the strategy should provide some flexibility to respond to the opportunities presented in each street.

RESIDENTIAL STREETS

Successful tree establishment in residential streets is critical and a primary focus of this Strategy.

On average Council needs to replace approximately 1,800 trees per year due to death, poor health, storm damage and vandalism. Many streets throughout Moreland contain a mix of tree species. In these streets, it will be difficult to achieve the vision of consistent avenues through infill planting. In the short term the objectives of maximising tree canopy and achieving consistent street tree plantings may be conflicting in many streets.

The importance of, and Council's preference for, consistent planting to improve the street landscape context should be effectively communicated to the local community. This will assist in instances where tree removal and new planting is required to achieve consistency and in instances where residents have planted trees in the street.

The aim of the annual street tree infill program is to ensure that Moreland's overall street tree population is sustained through a scheduled annual street tree replacement program. This tree planting program together with adequate management services is the primary driver for ensuring maximum tree canopy coverage within streets across the municipality into the future.

When street trees are removed as a result of age and general decline it is imperative that new trees are promptly replanted during the following planting season.

It is critical that Council puts in place both adequate measures and resources to ensure a more systematic approach to the replacement and successful establishment of street trees. This Strategy includes a number of recommendations and measures to rectify these issues. A Council commitment to a tree canopy and successful establishment target, together with regular monitoring of tree establishment through improved management and the incorporation of trees within Council's asset management system are critical if the street tree population are to be sustained and the Vision of this strategy realised.

BLOCK PLANTING

Block removals and replacements should be considered in streets where the trees are underperforming, of poor health and have short useful life expectancies. This approach should focus on streets, with wide nature strips and no overhead powerlines, where large trees can be planted.

ROAD AND CAPITAL PROJECTS

Council's civil works program for its buildings, roads, drains, footpaths and transport has been developed as a part of the Road Asset Management Plan for Moreland. Each year a number of residential streets are scheduled for partial or complete reconstruction. This program affords Council one of its greatest opportunities for improving residential streets through the provision of new street trees and vegetation. Good road design can allow space for street trees and vegetation where little or none previously existed. This is particularly important for the southern end of the City where current opportunities for street trees can be limited.

It is important that the cost of street landscaping and tree protection is incorporated into the overall cost for each street reconstruction project. It is also imperative that, those responsible for the management and development of street trees and vegetation within streets are consulted during the design phase of each project. This will ensure adequate measures can be taken to protect existing street trees and discuss any requirements to reduce/increase nature strip size so that opportunities to optimise new street trees and vegetation are considered.

9. COMMUNITY CONSULTATION

Being open and accessible to members of the community and offering timely opportunities for input that can influence the outcome are integral to consultation. The extent of the landscape works proposed and the impact on the park and street landscape will determine whether community notification or consultation is required and to what degree.

A short term action of this Strategy is to produce a series of decision making flow charts that ensure a consistent and transparent process in regard to the level of community consultation, timeframes and responsibilities.

Previously, the degree of community consultation was determined by the extent of the landscape works proposed and the impact on the landscape. The majority of tree planting to date has been undertaken on the premise of a Council mandate. Going forward, it is expected that new street tree plantings are likely to be more difficult to occur with resident opposition. It is therefore proposed that residents are provided with some choice in the planting of a tree in front of their house. Resourcing constraints however will make such a program unfeasible unless a Greening Officer position is created within Council.

The proposed community consultation program is more resource intensive than current procedures, however the benefits of getting residents engaged in increasing the urban forest should outweigh the cost in the long term through greater acceptance and survival of trees. The street planting plan outlines the proposed planting activities for a 5 year period and reinforces to the community that Council is undertaking tree planting in a prioritised and systematic way. The planting plan should also be displayed on the Council website so that it is easily accessible for the local community.

An open and accessible approach to street tree planting is a critical part of building confidence in improving the amenity of Moreland's streetscapes. It acknowledges that providing residents with the opportunity to comment in a timely manner can improve urban forest outcomes.

The extent of consultation should be determined by the scale of landscape works proposed and the impact on the street landscape. Previously under the 5,000 annual tree planting program, consultation was generally limited to informing residents after trees were planted. However, under the reduced 3,500 annual street tree planting plan, Council is proposing to trial a consultation hierarchy approach to ensure greater understanding and support of proposed vacant site tree planting.

CONSULTATION PROCESS

Major park or street landscaping works will involve community consultation particularly for projects such as play space renewals, park landscape plans, road reconstruction, implementation of local area traffic management schemes and the rejuvenation of street landscapes.

Consultation regarding major street landscape works should include the following elements:

- distribution of a letter to households affected by the street landscaping during the planning stage prior to development of designs or plans
- letter to advise of the proposed works, when it is likely to occur and extend an invitation to have input either verbally via telephone, in writing via email or letter, or at a community meeting (time, date and place of meeting to be included in the letter); and
- incorporate the community feedback into final plans and advise those who have provided input and households affected by the street landscaping of the final design and implementation timetable.

For major projects, the letter to households should be distributed at least four weeks before the proposed commencement of planting during the design/planning stage. The letter is to include:

- benefits of tree planting;
- a description of the proposed landscaping or tree planting;
- the proposed dates for finalisation of plans and commencement of implementation;
- the time, date and place for a community meeting to discuss design and implementation issues;

- contact details for feedback regarding the planting;
- the timeframe for feedback; and
- the process for dealing with feedback.

How information is presented during consultation is an important consideration so that everyone can understand the proposal. Graphically representing proposed landscaping, particularly 'before and after' pictures would assist where this is possible.

NOTIFICATION

Notification is the most straightforward mode of communication with the community and is likely to be the most common in the implementation of the Moreland Urban Forest Strategy. Currently residents are only notified at the time of planting.

If resources are provided, the notification of minor street landscape works could occur by the distribution of a letter to households where works will be undertaken, a week before the scheduled works. This will assist in engaging the community and be a catalyst for getting the residents interested in caring for their tree. For general tree planting works, a pamphlet should be development in line with the Street Tree Planting Notification decision making process and include the following:

- benefits of street tree planting
- tree species to be planted
- the size of the tree stock being planted
- the proposed date of planting
- contact details for feedback regarding the planting
- the timeframe for feedback
- the process for dealing with feedback

In the instance of annual infill street planting where works are planned well in advance, it might also be appropriate to provide some general information to the community well in advance of street landscaping works and then more specific information closer to the time of implementation. The Open Space Maintenance Group could notify the community through the local papers of neighbourhoods to be planted in the coming winter and then provide a letter to households that will have a tree planted outside in the weeks preceding planting. Alternatively the same information could be made available on Council's website on an annual basis. The information provided could include:

- benefits of street tree planting and overview of Council policy/strategy for street landscapes
- an indication of tree species to be planted
- notification process that will occur prior to planting
- contact details for feedback at this stage

Again this is more resource intensive than current procedures, however the benefits of getting residents interested in increasing the urban forest would outweigh the cost in the long term.

REQUEST A STREET TREE PROGRAM

Through the Urban Forest Strategy, Moreland City Council offers residents a free street tree planting service to residents and businesses. Tree species will be determined by Council in line with the Street Tree Planting Plan.

Street trees can be requested for:

- your nature strip or street;
- to replace a dead or vandalised tree; and
- in a new subdivision (older subdivisions are prioritised).

You will need to tell us:

- where you want the tree
- if you live at the location
- your name
- your contact number

After residents request a tree, a Council Officer will review the request in line with our annual street tree planting program and then contact you to explain timing and a suitable tree species for your street. Tree planting will normally take place between April and September Requests outside these seasons will be held until the next planting season where possible.

Council encourages residents to water the tree/s for at least the first three summers after planting.

URBAN FOREST STRATEGY CONSULTATION

Initial consultation with the community regarding the street tree plan and urban forest strategy commenced in October 2015 and will continue until May 2017. In order to ensure that a broad cross section of the community were represented in the consultation Council met with and sought feedback through a variety of mediums, including festivals stalls, community presentations, an online feedback page, meetings with local residents, community groups and students.

Additional public consultation on the draft strategy will occur following Council endorsement.

Key themes to emerge from the community consultation on the background to the draft Urban Forest Strategy included:

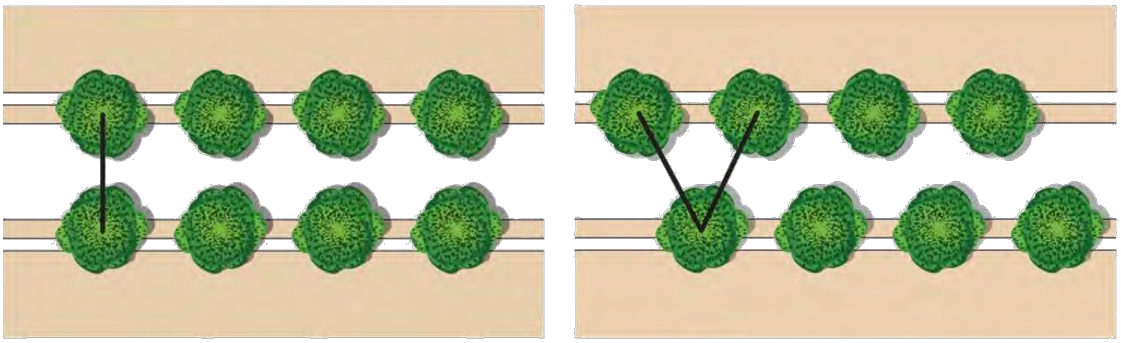
- Strong community interest in greening the municipality including increasing tree planting and the use of larger shade trees in streets and parks.
- Strong awareness in the community of the need for the right tree in the right place to avoid infrastructure damage, minimise water use and maximise shade.
- Widespread concern about the loss of significant trees in the private realm through urban consolidation.
- Disappointment with the planting of small trees and an over reliance on Callistemon genus.
- Diverse views on tree species preferences with many wanting to see more deciduous canopy trees in our streets and parks as well as productive trees. This seems to be a higher priority than planting a particular tree type such as indigenous species, although requests for maintaining indigenous and native planting particularly along waterways and habitat corridors (Reference Document 3) remained strong.
- Complaints about leaf, seed, fruit and flower litter from trees as well as concerns around limb failure during storm events.
- Most people expressed a desire for improved levels of maintenance of parks, street trees and garden beds with specific concern about the apparent lack of formative maintenance and high level of underperforming and dead trees.
- Most people are aware of the reduced water availability for trees and open spaces and are worried about the impact of the drought on trees. There were comments about the need for council to take action to increase the amount of water available to trees through such things as passive irrigation and raingardens.
- Divided opinions relating to net community benefit versus individual benefit. For example, inability to prune limbs overhanging private property, the removal of mature trees causing damage to infrastructure and the issue of planting trees for shade that block views.
- Many people indicated that they would be prepared to participate in community planting activities as well as water trees and nature strips in their street.
- The community want to be informed, engaged and involved in relation to street and park trees.

Copies of the draft Moreland Urban Forest Strategy will be made available to the community for further review and comment over a four week period following Council endorsement online and through Moreland's library network. All comments will be considered for inclusion in the final document for Council to consider.

10. STREETSCAPE DESIGN

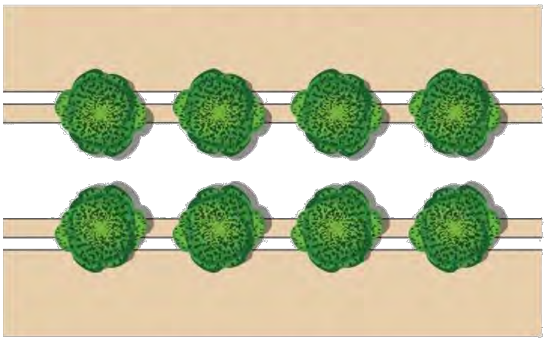
Figures 44 and 45 provide an overview of typical streetscape planting design options and illustrate a more detailed streetscape planting design highlighting the priority of planting street trees, the size of the trees and the selection of evergreen or deciduous trees. Priority planting relates to orientation and street canyon width to height ratio; tree size varies according to building setback and powerlines; deciduous or evergreen varies according to neighbourhood character, building height and footpath width. Additional tree planting options may involve tree plantings in centre median and in-road cut-outs - these planting situations will generally require specific planting site design and construction based upon traffic flow, site usage and project outcomes.

Figure 44. Typical streetscape planting design options

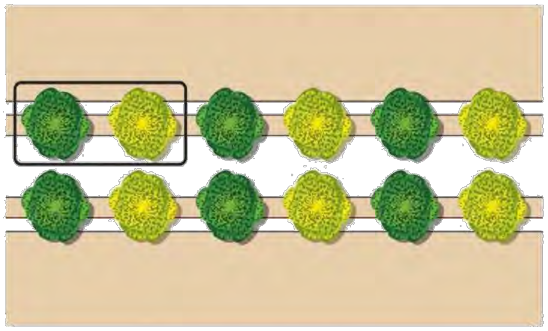


Opposite planting configuration

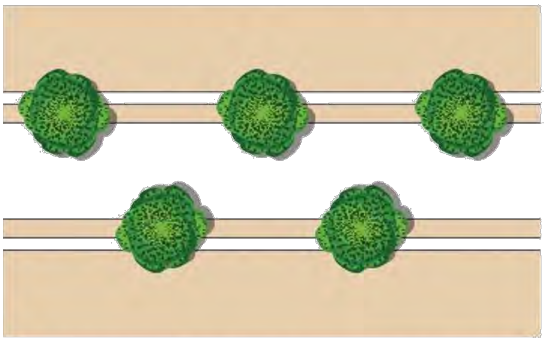
Alternate planting configuration



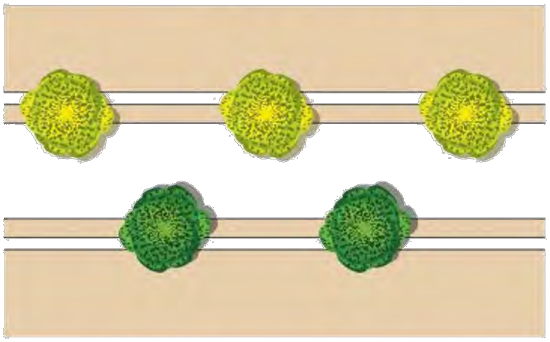
Single tree species avenue



Alternating tree species avenue

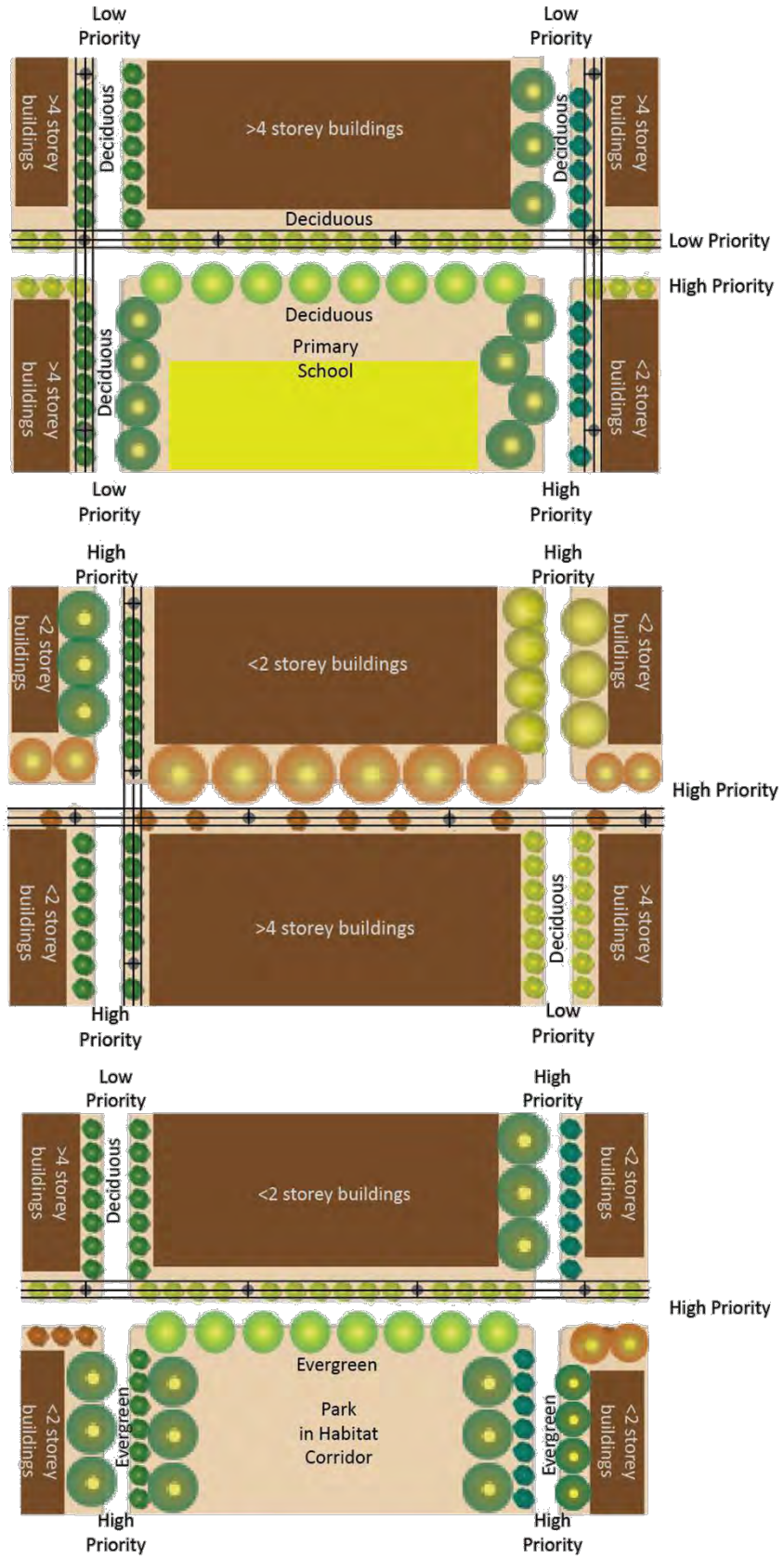


Single species alternate carriageway planting



Two species alternate carriageway planting

Figure 45. Typical streetscape and intersection planting design options



118

11. URBAN SPACE CONSTRAINTS FOR TREES

There are a number of existing urban assets and constraints that need to be considered as part of the street tree planting plan, such as safe clearances for street trees from existing underground and aboveground services like sewer, electricity, street lights, communication, gas, stormwater, water and other surface utilities (pit lids, kiosks, cable stays), and street signage (Table 22). From a transport safety perspective all new trees planted within road reserves must maintain sightlines at intersections and cross overs as well as setbacks from traffic signals.

The increase in street tree numbers and a shift to larger tree canopy species will invariably lead to conflicts with these existing assets, for example conflict between tree roots and footpaths or property damage. It is important to understand the various causes of infrastructure damage and where appropriate take actions to minimise the risk of damage occurring. In the case of footpath damage, Council may consider more appropriate tree species and site selection or for existing trees then a range of strategies such as root pruning or the installation of root barriers may be considered.

A considerable responsibility for Council's open space team is complying with legislative clearance requirements for trees around above ground power powerlines. This requires regular clearance pruning to attain required clearance distances. The 2015 amendment to the Electricity Safety (Electric Line Clearance) Regulations introduced greater flexibility to street tree pruning to reduce the impact on amenity whilst ensuring safety and reliable power supply.

As part of the Street Tree Planting Plan, a tree selection calculator (see Reference Document 1) has been developed to assist Council in selecting appropriate tree species for the width of nature strips and the presence of overhead powerlines. Only small trees or medium tree species that can be cyclically or directionally pruned are recommended beneath low voltage power lines and aerial bundle cables. Only tree species that can be cyclically pruned are recommended beneath high voltage power lines. Appropriate tree species for beneath power lines are identified within the Moreland Street Tree Species List 2016 in Reference Document 1.

As the population increases and urban consolidation continues in Moreland there is pressure to increase the size and number of vehicle cross overs, which can add pressure to existing trees (Figure 66). Improved co-ordination with developers and Council's planning department is required to ensure the sustainable management of existing street trees while ensuring new developments provide suitable space for canopy trees.

Details of setbacks and clearance guidelines are provided in the Moreland Street Landscape Strategy (2012) and are listed in Table 22. Where practical, Council will aim to achieve the horizontal and vertical clearances for existing services and structures listed in Table 22 for new trees.

Unfortunately, if Council were to map out all of these clearances then it is likely that there would be few street trees remaining in Moreland. It is therefore important to ensure a sensible and balanced approach is adopted to provide opportunities for street trees while ensuring community and asset safety. A good example of such a balance is the gradual rolling out of 40km/h speed limits in residential zones which allows for greater opportunity for street trees to play a role in traffic calming and shading with reduced clearance zones.

Traditionally, trees have been located in nature strips to avoid disturbance of services and infrastructure, and so as to not impede the safe use of, and access to, the road, footpath or adjoining properties. However, nature strips and footpaths across Moreland are typically used for many services. In addition, footpaths in many parts of Coburg and Brunswick are very narrow. As a result, Council is looking at suitable opportunities and potential sites for planting trees in-road with passive irrigation. These locations provide the following benefits:

- Traffic calming in residential streets;
- Intercept stormwater flows and pollutants;
- Improve tree health through passive irrigation for trees;
- Provide greater tree canopy benefits away from overhead powerlines; and
- Lessen conflict with underground services.

Table 22. Transport safety clearance guidelines

GENERAL HORIZONTAL CLEARANCE GUIDE FOR NEW TREES

Bus Stops	12 metres approach side/ 3 metres depart side	**SERVICES**	
		Gas (Low Pressure)	1 metre
Children's Crossing	18 metres	Gas (High Pressure)	3 metre
Parking Signs	2 metres	Electrical (66 KV)	3 metre
Pedestrian Crossings	10 metres	Electrical (HV)	1 metre
Street Furniture	0.6 metres	Electrical (LV)	0.3 - 0.5 metres
Street Sign	0.6 metres	SWER Transformer Pole	10 metres
Traffic Lights	18 metres	Sewer	0.3 - 0.5 metres
STREET LIGHTS (refer to MSLS)		Stormwater	0.5 metres
Street Lights (Residential)	10 metres	Telecommunications (Fibre)	0.5 metres
Street Lights (Primary)	15 metres	Telecommunications (Copper)	0.3 metres
Street Lights (Secondary)	10 metres	Underground Cables	0.3 - 0.5 metres
Street Lights (Arterial)	15 metres	Water	0.3 - 0.5 metres

ROAD SETBACKS (refer to MSLS)

Residential Streets	9 metres from intersection	Major Arterial Road	18 metres from intersection
Primary Connector Road	18 metres from intersection	Driveways	3 metres
Secondary Connector Road	9 metres from intersection	Kerbs	0.3 - 1.2 metres

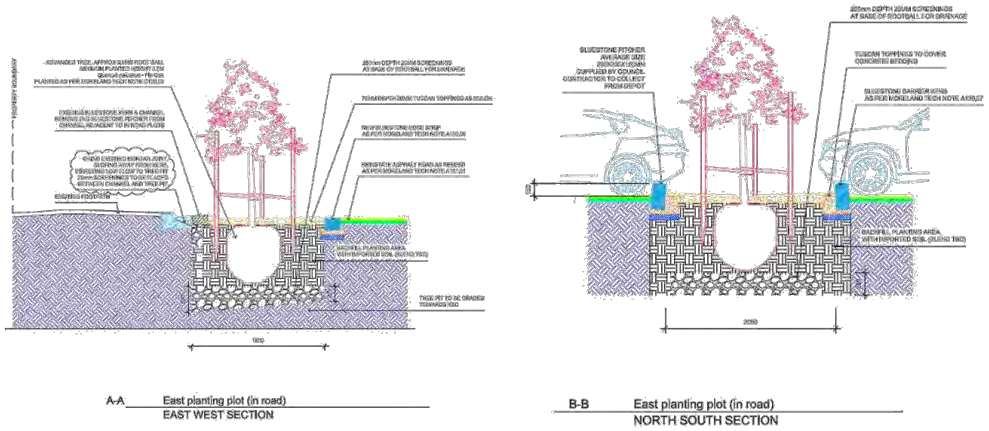
UNDER-PRUNING (IE CROWN LIFTING) OF TREES TO ACHIEVE THE FOLLOWING VERTICAL CLEARANCES

Footpath	2.4 metres	Residential Streets	3 metres
Parking Area	3 metres	Primary Connector Road	4.3 metres
Bike Path	3 metres	Secondary Connector Road	4.3 metres
Street lights	3 metres	Major Arterial Road	4.6 metres

High Street Coburg Better Streets program – community greening initiative

In 2016, Council carried out an in-road street tree trial in High Street Coburg. High Street had very few street trees, the nature strips were narrow and yet the residents were very interested in improving the streetscape. With the generous support of Melbourne Water's Living Rivers Fund and the local residents, Council have planted 16 advanced large canopy trees in the road that will be passively irrigated as illustrated in Figure 54. A further 32 medium canopy trees were planted in the footpath incorporating passive irrigation designs.

Figure 46. Cross-Section of High Street In-Road Passive irrigation Tree Pit Design



The High Street project is estimated to increase tree canopy cover from less than 5% currently to 67% as well as improve pollutant and stormwater flows. This has been achieved by providing an opportunity for the large canopy trees to be planted in the road to demarcate parking bays. It is expected that the newly planted trees will within 20 years decrease summer temperatures in the streetscape by 3-4 degrees Celsius, compared to a non-treed street. Extensive community consultation with residents contributed to a successful outcome, and notably there was majority support for this project by demonstrating that increased tree planting would not impair the integrity or functionality of the street. The trial was a valuable capacity building project within Council and for our contractors to better understand how to realise the multiple benefits from increasing vegetation in our streetscapes.

Trees planted in parking lanes should be spaced to maximise canopy cover along streets while allowing for efficient kerbside parking layouts (e.g. with clear parking bay lengths of two or three cars). Trees planted in parking lanes and medians should be large canopy trees, with all branches high enough to be clear of vehicles. Species with pendulous branches must not be used. Protect trees in parking lanes and centre of road medians from vehicle impact by using, in order of preference:

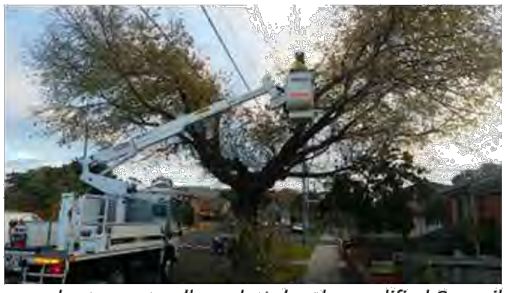
1. wheel stoppers
2. Bollards or tree guards
3. Kerbs

Such locations will require design interventions with siting and species selection for each site allowing for adequate vision for normal use of the area by drivers and pedestrians at the time of planting and during normal growth of the tree through to maturity.

To ensure appropriate setbacks and clearances are achieved and maintained during tree planting projects the following Acts, Regulations and Codes of Practices shall be referred to and adhered to:

- VicRoads Tree Planting Policy 2016
- VicRoads Road Design Notes
- Austroads Guide to Road Design
- Austroads Guide to Road Safety
- Austroads Guide to Traffic Management
- AASHTO, 2011, Road Design Guide
- Electricity Supply Act 1998
- Gas Safety Act 1997
- Water Act 1994
- Occupational Health and Safety Act 1985
- Pipelines Act 1967
- Telecommunications Act 1997
- Telecommunications Codes of Practice 1997
- Code of Practice: External Telecommunications Cable Networks Industry Code (C524:2013)
- AS/NZS 1158.6 Lighting for Roads and Public Spaces
- Code of Practice: WorkSafe Victoria
- Code of Practice: Safety Precautions in Trenching Operations
- Code of Practice: For Confined Spaces

Figures 55 through to 57 provide recommended minimum clearance guidelines for Council's tree pruning works in regard to footpaths, shared paths and primary roads. Other roads require a minimum 3.5 clearance if they are planted next to the vehicle lane to minimise impact with vehicles such as rubbish collection and street cleansing.



Street electrical line clearance works are generally undertaken by qualified Council Arborists in compliance with Electricity Safety (Electric Line Clearance) Regulations 2015 (see Table 22 for clearances)

Figure 47. Minimum tree (crown lifting) clearances over footpaths

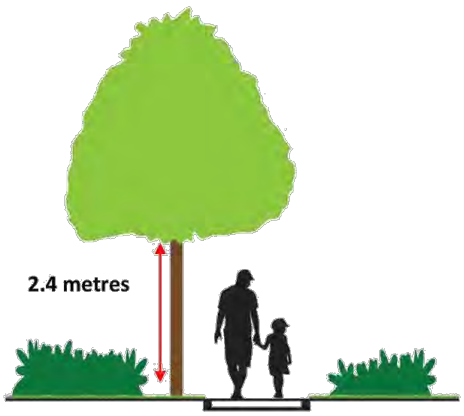


Figure 48. Minimum tree (crown lifting) clearances over a bike path

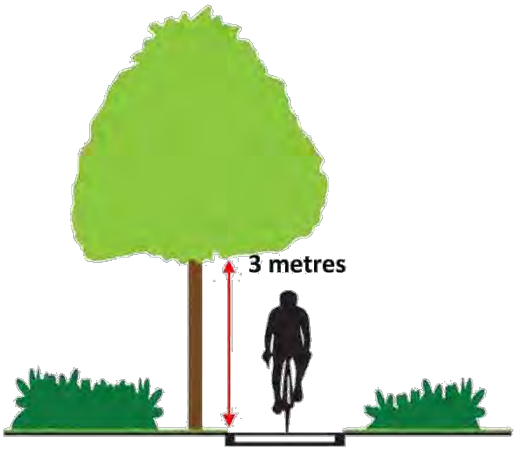
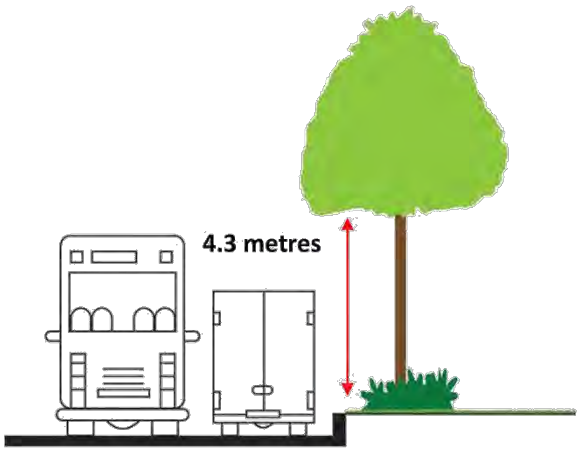


Figure 49. Minimum clearances over a primary or secondary connector road



123

12. STREETSCAPE TREE PLACEMENT OPTIONS

Figures 46-51 provide some examples of typical tree planting situations in streetscapes including tree planting options such as in-road cut-outs - these latter planting situations will generally require specific planting site design and construction based upon site usage and project outcomes.

Figure 50. Typical road reserve planting

Figure 51. Road reserve with no footpath

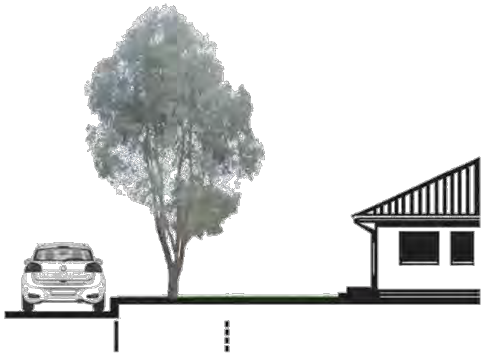


Figure 52. Footpath between road and road reserve

Figure 53. Narrow road reserve

Figure 54. Raised planting bed

Figure 55. In-road planting

13. VACANT STREETS AND PROPOSED PLANTING STREETS

Table 23. Vacant Streets

Street Name	Suburb	Potential Sites
Allen Street	Coburg	6
Balderrie Court	Gowanbrae	19
Baxter Street	Coburg	9
Carlisle Street	Coburg	6
Cocoa Jackson Lane	Brunswick	4
Cozens Street	Brunswick	18
Duckett Street	Brunswick	7
Eckersall Street	Brunswick	6
Evans Street	Brunswick	59
Linden Street	Brunswick East	14
Morgan Court	Glenroy	6
New Street	Brunswick	6
O'Connor Street	Brunswick East	11
Peveril Street	Brunswick	19
Rope Walk	Brunswick	6
Wilson Avenue	Brunswick	7

Table 24. Potential Planting Streets

Street Name	Potential Sites	Street Name	Potential Sites	Street Name	Potential Sites
Aintree Street	1	Evans Street	59	Murdock Street	32
Albert Street	76	Ewan Street	1	New Street	6
Allan Street	2	Ewing Street	31	Newman Street	24
Allen Street	6	Finchley Avenue	1	Oconnor Street	11
Barkly Street	10	Florence Street	17	Pascoe Vale Road	11
Baxter Street	9	Glenroy Road	5	Peveril Street	19
Belair Avenue	6	Hartington Street	2	Phoenix Street	25
Bell Street	1	Hope Street	82	Reynard Street	76
Blenheim Street	9	Ingham Street	1	Rogers Street	8
Brunswick Road	13	James Street	1	Rope Walk	6
Burnell Street	1	Linden Street	14	Ross Street	16
Cameron Street	18	Little Breese Street	1	Stewart Street	4
Carlisle Street	6	Lyle Street	2	Tinning Street	40
Cliff Street	2	Lytton Street	6	Trafford Street	8
Cocoa Jackson Lane	4	Manallack Street	4	Union Street	2
Connelly Street	3	Marlborough Street	13	Upfield Bike Path	2
Cozens Street	18	Merrifield Street	7	Victoria Street	67
Davies Street	7	Michael Street	4	Weston Street	12
Dawson Street	15	Minnie Street	1	Wilkinson Street	18
Dowd Place	11	Mitchell Street	13	Wilson Avenue	7
Duckett Street	7	Morgan Court	6		
Eckersall Street	6	Mountfield Street	2		
Edward Street	17	Munro Street	24		

14. SPECIES RATINGS & CALCULATOR

Trees provide environmental, ecological and amenity benefits, with some species providing greater benefit than others. Each species within the provided list has been rated according to its environmental, ecological, pest and disease susceptibility, climate change adaptability, life expectancy and amenity benefit.

The following is a summary of the rating methodology used.

Total Environmental Benefit Rating

Trees in urban areas contribute significantly to human health and environmental quality by providing various ecosystem services (i.e. the conditions and processes through which ecosystems sustain and enhance human life). To better understand the ecosystem services and values provided by trees, the

U.S. Forest Service developed i-Tree Eco. The results from i-Tree models are used to advance the understanding of tree and forest resources; improve urban forest policies, planning and management; provide data to support the potential inclusion of trees within environmental regulations; and determine how trees affect the environment and consequently enhance human health and environmental quality in urban and rural areas. Further details about the methodology, calculations and values can be sourced at: http://www.itreetools.org.

Each species has been comparatively rated for its average mature iTree Eco valuation for Carbon Storage, Annual Carbon Sequestration, Annual Rainfall Interception, Annual Pollution Removal, Annual Heating Offset Value, and Annual Cooling Offset Value. The average rating for all iTree Eco valuations is used to formulate a Total Environmental Benefit Rating.

Amenity Benefit Rating

Community preferences reveal a strong emphasis on amenity values over and above ecological or economic benefits of street trees. Urban streetscape trees provide significant economic and social benefits directly and indirectly to the community. Trees are key components in facilitating a sense of place, community, neighbourhood character and social interaction. Tree lined streets can increase property values, improve retail patronage and income, reduce crime, increase physical activity, improve mental health and expedite recovery from medical care.

The Amenity Benefit is based on methods from the Council of Tree and Landscape Appraisers (1992) Compensatory Value which is provided within iTree Eco. Each species has been comparatively rated for its average mature Amenity Benefit.

Pest /Disease and Biosecurity Rating

There are innumerable pests and diseases that can affect trees; however susceptibility differs from species to species. To minimise the potential for tree loss through issues of pest, disease and Biosecurity, diversity within the urban forest is paramount to its survival, longevity and succession. Each tree species has been rated according to its documented susceptibility to pests and diseases, and potential Biosecurity issues. Superficial pest and disease issues such as scale, mildews etc. have been discounted in comparison to more severe issues such as Phytophthora cinnamomi.

Ecology Rating

Trees are an important part of terrestrial ecosystems, providing essential habitats and food for communities of organisms. Each tree species has been rated according to its potential ecological value. The rating utilises species specific information pertaining to: origin (i.e. indigenous, native or exotic); bark type (e.g. fibrous, fissured, smooth); and inflorescence (e.g. flowers abundant, clustered, inconspicuous). These species attributes have been weighted according to their potential ecological benefit to formulate an Ecology rating.

Useful Life Expectancy Rating

Tree species have variable longevity, particularly within urban landscapes. Each tree has been rated according to its known or expected life expectancy within a streetscape, with greater ratings afforded to trees that have greater longevity.

Climate adaptation ranking

While the impacts of climate change on urban biological systems cannot be known, the potential effects and implications can be predicted. A species' resilience and tolerance to issues of drought, flood and humidity can offset the effects of changes in local climatic conditions, and facilitate its potential survival and longevity within the urban forest. Each tree has been rated according to its known environmental tolerances in lieu of predicted changes in local climatic conditions for Moreland.

15. SOIL HEALTH GUIDELINES

Issues such as soil compaction, poor aeration, extreme pH, poor infiltration, reduced soil nutrition, and low microbial activity can significantly affect tree health and reduce longevity. Therefore ameliorative works will be required to maintain trees and prepare sites for tree planting.

The potential design tree plantings many of which are to be located in-road. Soil conditions under asphalt are heavily compacted. As such the soil conditions are almost completely opposite those preferred by trees. Excessive soil compaction is considered the most important factor affecting tree health since it affects soil water availability, soil aeration and soil drainage.

To facilitate improved soil environments around existing trees, the following information and guidelines are provided:

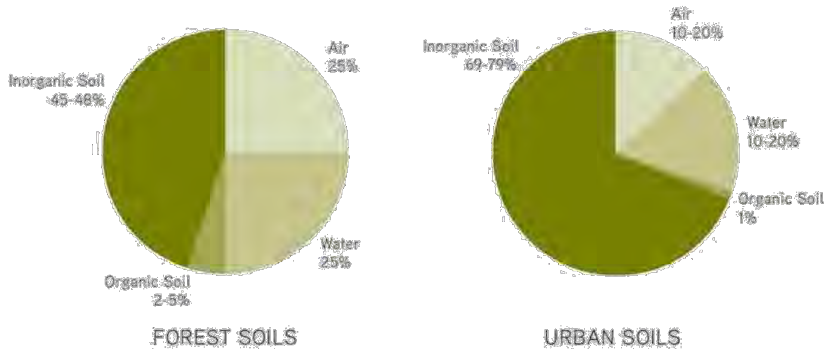
- Fertigation and Fertilisation
- Mulching
- Plant Pathogens
- Soil Decompaction
- Suspended Pavements
- Rock Base Planting System
- Vertical Mulching

These guidelines and information may not be practically utilised in many urban situations, but where practicable they can improve soil health to facilitate improved tree health and longevity.

FERTIGATION AND FERTILISING

Urban soils typically comprise material that has been manipulated, disturbed or transported by activities in the urban environment. As a result, its physical, chemical, and biological properties are generally less favourable for plant growth than soil found in natural landscapes (Figure 56). The mixing, filling and contamination that occurs to create urban soils can remove organic matter, topsoil and structure, which are all vitally important to soil health; and can contain material such as glass, waste wood, metal, asphalt, masonry, and plastic, which can negatively affect plant growth.

Figure 56. Contrasting physical, chemical and biological materials of forest soils and urban soils



Soil fertility is generally the result of inheritance from the parent material (i.e. rock). Sandy soils are primarily derived from quartz rock and commonly have little nutrient value. Silt and clay soils are typically derived from basalt, limestone and shale which commonly have high nutrient value. Therefore, the fertility of urban soils can be highly variable, depending on levels of disturbances, composition of natural and man-made materials, and the types of process and activities that have historically occurred. Soils deficient in organic matter, nutrients and structure can result in reduced plant growth, poor plant health, and greater susceptibility to pests and diseases. Therefore, urban soils can often require improvement to facilitate healthy plant growth with practices such as fertilising and fertigation.

Fertilising refers to the practice of adding supplemental nutrients (chemical elements), required for normal tree growth and development, but which are otherwise absent in the trees growing environment. Fertigation is the use of fertilisers, soil amendments and other water soluble products in an irrigation system or a soil environment. Both are used to add additional nutrients to a soil environment or to correct nutrient deficiencies detected by plant tissue or soil analysis.

Basic fertilising treatments involve the use of mulches and composts, which can improve biological and nutrient content, can be conducted all year round, and require minimal site analysis prior to treatment. More complex fertilising and fertigation requires detailed investigation of the physical, chemical, and biological properties of the soil and plant. This typically involves basic and/or advanced soil testing, and will require the use of specialised staff or contractors to determine the most effective assessment and treatment program. Treatments will use specific biological (fungi, bacteria, nematodes etc.) and chemical (macro- & micro-nutrients) ameliorants to address deficiencies.

Table 25 provides a summary of the Macro- and Micro-nutrients essential for plant nutrition.

Table 25. Essential plant nutrients

Essential Plant Nutrients	
Macronutrients	**Micronutrients**
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O)	Boron (B)
Nitrogen (N)	Molybdenum (Mo)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Zinc (Zn)
Calcium (Ca)	Chlorine (Cl)
Magnesium (Mg)	Nickel (Ni)
Sulphur (S)	Cobalt (Co)
	Sodium (Na)
	Silicon (Si)

The basic soil testing steps are:

1. Identify poor plant health and causes
2. Determine intervention required
3. Conduct appropriate tests
4. Utilise appropriate fertilising and fertigation
5. Monitor plant responses

Further information can be found at www.agriculture.vic.gov.au

MULCHING

Trees growing in a natural forest environment have their roots anchored in a rich, well-aerated soil full of essential nutrients and soil microorganisms. The soil is blanketed by leaves, organic materials, and living organisms that replenish and recycle nutrients. This environment is optimal for root growth and nutrient uptake. Urban landscapes typically have poor quality soils, reduced organic matter, and large fluctuations in soil temperature and moisture.

Within urban environments, mulching is one of the most beneficial practices to facilitate better tree health; however, in most urban situations mulch is absent or poorly maintained. Mulches are woody materials placed over the soil surface to maintain moisture and improve soil conditions.

BENEFITS OF PROPER MULCHING

- Improved soil biology, aeration, structure (aggregation of soil particles), and drainage
- Improved soil fertility from decomposition
- Inhibition of plant diseases
- Insulation of soil from summer and winter extreme temperatures
- Protection from mechanical damage by machinery, vehicles and people
- Reduced soil moisture loss through evaporation
- Weed control

Types of mulch

The two major types of mulch are inorganic and organic.

Inorganic mulches include various types of stone, rock, pulverized rubber, geo-textile fabrics, and other materials. Inorganic mulches do not decompose and do not need to be replenished often. However, they do not improve soil structure, add organic materials, or provide nutrients.

Organic mulches include wood chips, hardwood and softwood bark, leaves, compost mixes, and a variety of other products usually derived from plants. Organic mulches decompose and improve soil quality and fertility. Decomposition of organic mulches occurs at different rates depending on the material, climate, and soil microorganisms present, and consequently requires ongoing maintenance.

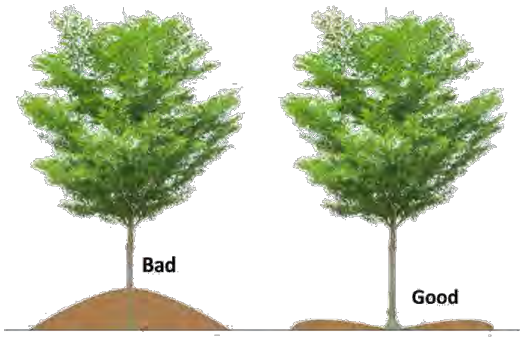
BEST MULCH

The best mulch to improve tree health contains a combination of woody materials, bark, and leaves; is composted for a minimum of 6 months; and is free of foreign pests and diseases. All mulches should be sourced from a reputable supplier or source, which has a thorough understanding of its history and constituents.

AMOUNT OF MULCH

As beneficial as mulch is, too much can be harmful. Excessive mulch can be effective in suppressing weeds and reducing maintenance, but it can instigate root and collar rots, promote pest and disease, affect soil pH, and reduce infiltration of water and soil gaseous exchange (Figure 57).

Figure 57. Contrasting practices for spreading mulch



Mulch should be applied to as much of the tree root plate as available and practicable. Ideally, mulch should be manually spread (i.e. no machinery) to an approximate depth of 5-10 cm. A mulch layer approximately 5-10 cm thick is generally regarded as similar to natural environmental conditions, and ideal to improve plant health (Figure 58). Therefore, approximately 5-10 cm of composted mulch should be maintained around all trees newly planted trees, and around mature trees where practicable.

PLANT PATHOGENS

Plant pathogens include organisms such as fungi, bacteria, viruses and moulds that can cause diseases in plants. Many pathogens occur naturally in soil and plants, and are an important component of functioning ecosystems. Others have been introduced, causing native plant species to be highly susceptible to infection.

Plant pathogens can survive in soil or plant tissue for long periods without causing an outbreak of serious disease. However, an outbreak can occur if a change in soil conditions creates an environment that favours growth of the organism, or if a plant is vulnerable as a result of an external stress. Trees in urban environments can be periodically or frequently exposed to modified soil and environmental conditions. Additionally, the predicted change in climate is likely to inflict particular stresses on trees within urban and peri-urban environments, which is likely to increase the susceptibility of some tree species to certain pests and diseases.

Plant pathogens known to be present, or have potential to be within Council managed areas include, but are not limited to:

- Canker disease (*Quambalaria* sp. and *Botryosphaeria* sp.)
- Dutch Elm Disease (*Ophiostoma* sp.)
- Fire Blight (*Erwinia amylovora*)
- Fusarium Wilt (*Fusarium oxysporum*)
- Honey fungus (*Armillaria luteobubalina*)
- Myrtle Rust (*Uredo rangelii, Puccinia psidii*)
- Root Rot (*Phytophthora cinnamomi*)

Figure 58. Common plant pathogens present in Moreland

Uredo rangelii

Armillaria luteobubalina

Fusarium oxysporum

Pathogens can affect both native and non-native plant species, and if no treatment is available to eradicate the pathogens, management generally focuses on controlling the spread and minimising the impact of the diseases. Where a disease issue is identified, and damage or threat of damage exceeds accepted thresholds all possible action should be taken to effectively negate the impacts. This will consist of an integrated management approach to employ methods, materials and services that preserve and augment the plant or ecosystem to facilitate opportunities for permanent control. This may include the use of physical barriers, chemical treatments, tree removal, or natural antagonists (e.g. *Trichoderma*) as biological controls. Barriers can reduce the spread of a pathogen, tree removal can eliminate an infected specimen but not the pathogen, and chemicals can eradicate a pathogen with potential environmental and human health consequences. Natural antagonists such as local and introduced *Trichoderma* species can be a critical component of a plant pathogen management plan, particularly against fungal and bacterial pathogens, as they have potential to control and/or eradicate pathogens with no environmental or human health consequences. However, natural antagonists should only be used after detailed scientific investigation and trial has been conducted.

To ensure that disease issues are managed appropriately and according to industry best management practices Council will aim to:

- Have a thorough understanding of the biology of the plants they are managing and the known and potential pest and diseases that could affect them.
- Engage specialists for advice, services, training and education.
- Work with other agencies or service providers to ensure best management practices.
- Remove infected trees or vegetation where the recommended control is not safe, applicable or financial viable to prevent transmission.
- Support research into controls and initiate additional monitoring systems where required.

SOIL DECOMPACTION

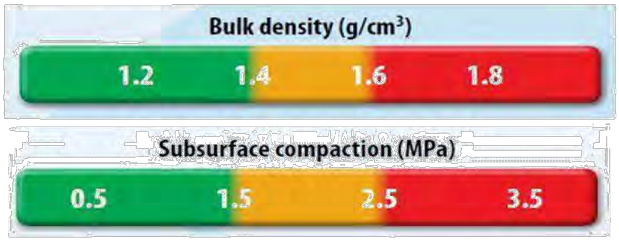
Urban soils can experience significant compaction as a result of mechanical disturbance and grading during construction and civil works. Afterwards, these soils may be further compacted by pedestrians, maintenance equipment, and vehicles. As a consequence, urban soils frequently exhibit significant resistance to root penetration, reduced water infiltration, and low rates of oxygen diffusion - all of which can impair the growth and function of tree roots (Day and Bassuk 1994).

Soil compaction occurs when soil particles are pressed together, reducing pore space between the particles. Heavily compacted soils contain few large pores and have a reduced rate of both water infiltration and drainage from the compacted layer. Excessive soil compaction impedes root growth and therefore limits the amount of soil used by roots, which can decrease the plant's ability to translocate nutrients and water - thus affecting canopy vigour.

The two measures most commonly used to assess soil compaction are bulk density and soil penetration force (i.e. penetrometer). Bulk density is measured in g/cm^3 and soil penetration is measured in MPa of psi. Soil bulk density greater than 1.5 g/cm^3 or soil penetration greater than 2 MPA (or 290 psi) are considered to be

root limiting in clay and typical urban soils (Urban 2008) (Figure 59).

Figure 59. Ideal bulk density and compaction ranges



Further information regarding soil compaction and these assessment methodologies can be found at: www.soilquality.org.au

Kelby et al (2011) established that soil decompaction processes can increase soil water content, reduce bulk density (i.e. compaction), and increase soil organic matter with the use of pneumatic injection machinery (Figure 60) when used with other soil amendments. The machinery injects compressed air through a hydraulic probe directly into the soil profile. The high pressure air creates cracks and fissures within the soil profile which can increase water infiltration and gaseous exchange. This process can also deliver oxygen into the soil to improve porosity and soil biota. It is noted however, that results are highly dependent on location and soil type (Smiley et al. 1990; Rolf 1994; Smiley 1994; Smiley 2001), and therefore, this methodology should be used within an integrated approach to soil health improvement.

Figure 60. Pneumatic injection machinery can increase soil organic matter

Soil decompaction should be conducted at a minimum of 0.5-1 metre intervals around the root plate of the affected tree in as much area as available beneath its canopy. Refer to the Vertical Mulching section for decompaction patterns.

PASSIVE IRRIGATION TREE PITS

Street trees are an essential element of our urban streetscapes that support healthy communities by providing a broad range of invaluable environmental, economic and social benefits. However, these benefits are rarely fully realised because street tree growth is constrained by urban landscape design issues that limit tree root access to water, air and nutrients. Trees thrive when they have access to generous soil volumes, healthy

soils and a reliable water supply. Unfortunately, for most streets such conditions are the exception. Instead, street trees are typically required to survive under stressful conditions characterised air pollution, by soil compaction, poor aeration, restricted soil zones, extreme pH, poor infiltration, reduced soil nutrition, concentrated pollutant and nutrient loads in stormwater, and low microbial activity.

SUSPENDED PAVEMENTS

Trees in streets and urban environments typically have limited access to soil due to the presence and proximity of roads, buildings and subsurface infrastructure; and due to compaction caused by paved surfaces, infrastructure construction, and ongoing pedestrian and vehicular movement. Access to viable soil is the most limiting factor for urban tree growth; affecting their structure, health, longevity and mature size.

To facilitate larger, healthier and longer lived trees within urban environments, suspended pavement systems can create significantly improved access to viable soil beneath roads and around subsurface infrastructure.

Suspended pavement is a general term for any technology that supports the weight of footpaths or roads to create a subsurface space that can be filled with soil for root growth. The soil that is used to fill the system can either be native, from the excavation area itself, or a specified mix to suit the desired landscape plants.

Suspended pavement systems can also be critical components for water sensitive urban design (WSUD), facilitating on-site stormwater management, maintaining pre-development hydrology, minimizing non-point source pollution and flooding, and recharging watersheds. Council's current WSUD package can be found at: www.moreland.vic.gov.au/environment-and-waste/water/wsud-design-package

Suspended pavements are ideal low-impact development design solutions for the long term co-existence of trees and streets, parking lots/lanes, roofs, promenades, plazas, green walls, and light-rail platforms.

Suspended pavement systems are specifically designed for a given site, and may involved pre- fabricated or engineered structures.

Pre-fabricated structures such as the Deep Root Silva Cell® (www.deeproot.com), CityGreen StrataCell® (www.citygreen.com), or Green Blue Stratavault® (www.greenblue.com) (Figures 61 and 62) are examples that can be incorporated into landscape design projects or retrofitted around mature trees. Alternatively, specifically engineered suspended pavement structures can be designed for landscape projects before development.

Figure 61. Prefabricated structural soil examples: Deep Root Silva Cell®; CityGreen StrataCell®; Green Blue Stratavault®

www.deeproot.com www.citygreen.com www.greenblue.com

133

ROCK BASE PLANTING SYSTEM

Based on the Stockholm System this technique involves creating a structured soil environment for improved urban storm water management and tree establishment with urban environments.

Tree planting pits are constructed with a foundation of granite stone or recycled concrete so as to assist stormwater flows and gaseous exchange within highly modified urban environments.

An 80:15:5 mixture of compost, biochar and chicken manure is added within the tree pit - it can be washed into the rock base during construction, or retained above the rock base with the use of a geo- textile. Biochar is made from agricultural waste (i.e. biomass) via slow pyrolysis (heating in the absence of oxygen). It is incorporated into the mixture as a soil amendment that can hold carbon, increase soil biodiversity, improve nutrient availability, and improve water retention.

The soil that is used to fill the system can either be native, from the excavation area itself, or a specified mix to suit the desired landscape plants. It is important that the soil contains a certain amount of clay and humus to maintain water and nutrient holding capacity.

The objective of the Stockholm System is to achieve improved tree health, longevity and vitality through improved:

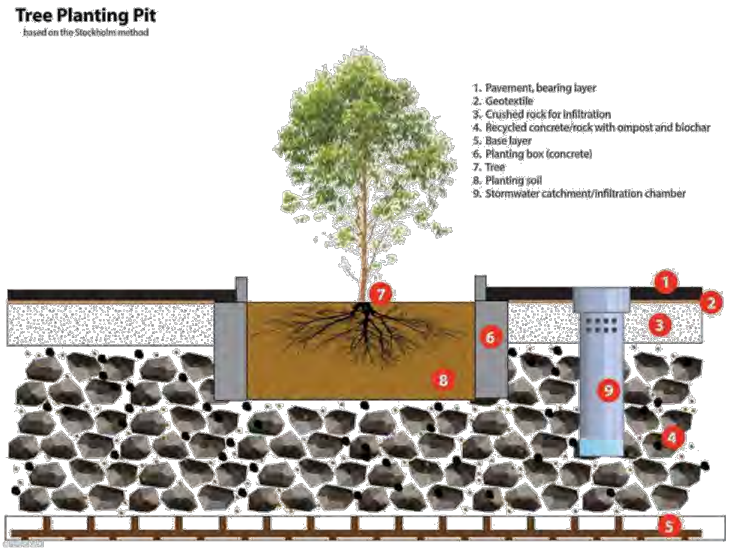
- Fertilisation and/or addition of organic material
- Rainfall infiltration
- Soil gas exchange
- Soil permeability
- Soil volume for trees
- Stormwater management
- Use of waste construction materials

Figure 62 provides a schematic of the core components of the rock based planting system.

The structural soil component should be gap-graded gravels made up of crushed stone and clay loam. Depth will vary according to design but should ideally be greater than 600mm.

The materials can be compacted to meet all relevant pavement design requirements (>95% Proctor density) yet allow for sustainable root growth. The new system essentially forms a rigid, load-bearing stone lattice and partially fills the voids with soil. Structural soil provides a continuous base course under pavements while providing a material for tree root growth. This shifts designing away from individual tree pits to an integrated, root penetrable, high strength pavement system.

Figure 62. Stockholm tree planting pit method



134

VERTICAL MULCHING

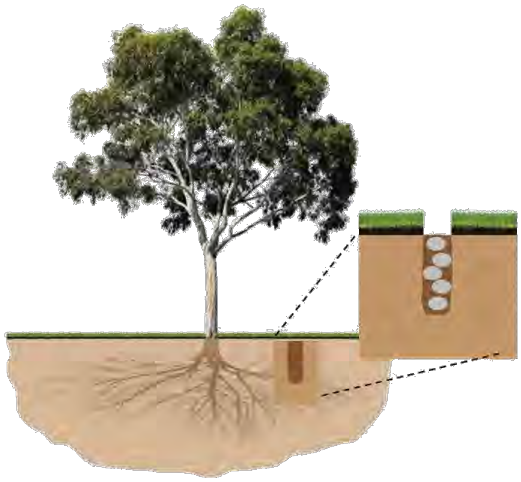
Vertical mulching is a procedure used on trees to achieve any or all of the following goals:

- Aeration of the soil
- Gaseous exchange
- Infiltration of rainfall
- Inoculation of the root zone
- Fertilisation of the soil
- Partial decompaction of the soil

PROCEDURE

Vertical mulching involves the creation of holes at regular or irregular spacing in the soil around a tree (Figure 63). Typically, holes are created directly beneath the canopy, from approximately 1 metre from the trunk outwards to beyond the drip line where practicable. It urban environments soil area around trees can have restricted accessibility. In these situations, holes are created as far as the site permits and that is practicable for its usage.

Figure 63. Vertical mulching method



DIMENSIONS OF HOLES

Holes are created approximately 10-20 cm in diameter and approximately 50-150 cm deep, depending on the equipment used.

EQUIPMENT

Earth augers and hydro-vacuum are the most commonly used machinery for vertical mulching.

Earth augers are cheap and easily accessible machinery, but can cause significant damage to roots when used around mature trees.

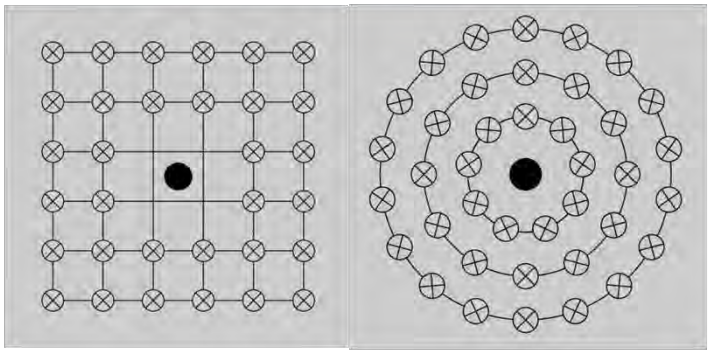
Earth augers typically mix the filling materials into the soil by drilling a shallow hole, scooping the right amount of filling materials product into the hole, and then finishing the drilling. The drill mixes the product with the soil while drilling the hole.

Hydro-vacuums can be more expensive, but can create vertical mulch holes that cause minimal damage to tree roots, remove soil waste immediately, and facilitate improved soil moisture. Holes are excavated and then backfilled with the required materials.

PATTERNS OF VERTICAL MULCHING

Drilling pattern should be specifically designed to each tree, its root plate, and the accessible soil area. Typically, holes are spaced 1 metre apart, in either a grid pattern (Figure 64 or a concentric circular). The end result is a pattern of evenly spaced holes throughout the area underneath the canopy of the tree.

Figure 64. Vertical mulching methods: grid and concentric patterns



FILLING HOLES

Holes are filled with a variety of different mixtures, depending on the intended effect:

- Aeration/Infiltration: washed river rock 20-50 mm diameter
- Fertility: mulch, fertiliser and washed river rock 20-50 mm diameter
- Inoculation: Mycorrhizal fungi, Trichoderma, rhizophore bacteria, or compost

16. PRUNING

TREE PRUNING

In a forest situation trees survive by shedding limbs, either by being squeezed off by competition or as a result of nature's extremes, but trees in streets require a much higher level of care to maintain their overall health, safety and aesthetics. Whilst pruning is the most commonly used tree maintenance procedure it requires care and expertise as pruning can either help or harm the tree depending on when, how and where the cutting is applied.

Unauthorised pruning works that lead to either permanent damage or that require remedial pruning may be followed up by Local Law enforcement. To avoid embarrassment, please contact Council if a street tree needs pruning and leave it to the experts.

PRIORITISATION OF PRUNING WORKS

Hazard Reduction Pruning (HRP) is recommended when the objective is to reduce the immediate danger to people and property such as:

- *Cracked or hanging limbs*
- *Trees causing vision problems for traffic*
- *Trees growing through overhead wires*

Maintenance Pruning (MP) is recommended when the objective is to maintain or improve the overall health of a tree. Examples of these are:

- *Trees hanging down over roads or footpaths but that are not yet an obstruction*
- *Trees where there is significant overhanging of property*
- *Trees growing near wires*

PRUNING OVER PROPERTY

In regards to requests for pruning over property lines consideration must be given to the related strategic goals of the Moreland Street Landscape Strategy (MSLS) which in regards to clearance of trees over private property are:

- To assist in adapting out city to climate change
- To mitigate the urban heat island effect within the municipality.

The MSLS acknowledges the importance of trees in the amelioration of climate change at a local scale by facilitating as one of its primary objectives an increase in tree canopy coverage and density across the municipality.

Council

The MSLS also outlines a strategic approach that includes the use of larger growing trees that will grow into property setbacks to provide shade to the property and therefore considers the undertaking of vertical or reduction pruning over resident's property as contradictory.

In regards to the above pruning interventions Council generally will only undertake tree canopy reduction pruning of Council trees over residents properties if:

- The tree is rubbing or significantly overhanging the building.
- The overhang within the property is less than 3 meters high.
- If there is a tree branch is hazardous or obstructing electrical wires

A CONSISTENT APPROACH

Pruning of Council trees can be a very emotive issue. Many residents, understandably, have strong views both for and against pruning. Council has a duty of care to reduce potential risks to the community and to comply with the legislative requirements. It is also necessary to balance these legislative requirements across the whole of Moreland's tree population so pruning works can be completed within an acceptable timeframe and in a cost efficient manner.

MANAGING RISK

Council has developed a tree inspection program where an AQF5 'Australian Qualifying Framework' or Diploma in Arboriculture trained Arborist will undertake risk assessments of potential hazards for Council's trees as required. These assessments are based on an internationally accepted tree risk analysis method and visual tree assessment process. Works are then prioritised in accordance with the identified risk, from most critical to least critical.

AREA INTEGRATED MAINTENANCE PROGRAM (AIM)

Council also has in place a cyclical tree pruning program called AIM. The AIM program involves rolling, area based

inspections of trees and the scheduling of any proactive tree pruning deemed necessary. The AIM program operates on a two year cycle (i.e. each area is inspected every 2 years). More information is available on Council's website or by calling Council's customer service centre.

WHY COUNCIL WON'T PRUNE TREES

There are a number of reasons as to why Council will not undertake tree pruning include:

- *Trees on private property that are overhanging footpaths, roads and laneways. This is the responsibility of the relevant property owners. Obstructions can be reported to Council's Urban Safety Unit for action.*
- *Providing clearance for Optus wires, Council have no responsibility to prune for these wires.*
- *To provide vistas (views) or requests for lopping of Council trees.*
- *The tree is considered too big or too old.*
- *For shading issues or where the tree blocks light into a resident's property or onto solar panels.*
- *Obstruction of satellite or other telecommunications signals.*
- *Where branch movement is activating residents movement direction lights.*
- *Problems associated with birds, bats or possums living in trees.*
- *The tree obstructs street lighting into a resident's property.*
- *For hindrances where residents are expected to undertake reasonable maintenance of their properties. (i.e. sweeping of tree debris such as leaf, bark and gum nut drop)*
- *Spiders or other insect issues (that are not affecting the health or viability of the tree).*
- *To provide for views of Business or Real Estate signage.*

17. MANAGEMENT OF PEST, DISEASE, ANIMAL AND WEED SPECIES

Pests and disease are a part of the urban forest. Council recognises that control measures will be required, at times, to maintain healthy, long-lived and vigorous trees in Moreland's urban forest. Council will adopt the principles of Plant Health Care to address pest and disease management with a focus on problem prevention through appropriate tree selection, planting and tree maintenance. Monitoring the urban forest will allow a timely and appropriate response. If problems do occur, multiple management options will be used to remedy them.

A range of methods will be utilised in the management of pest and disease outbreaks and the identification of damage thresholds will initiate the implementation of a pest and disease control program. Specifically, Council will approach pest and disease management as follows:

- Council officers will have a thorough understanding of the biology of trees and key pests in relation to the ecosystems they are managing. On-going training and education will occur for Council officers to maintain current best-practice approach to pest management.
- Council will support research into biological controls for pests and diseases that pose a threat.
- Monitoring systems will be developed to monitor tree health regularly – via the block pruning system – and this data will be updated and informed through new research and through pest and disease alerts from other agencies as new threats are identified.
- If a pest and disease is identified and damage thresholds exceed accepted levels (e.g. possible contagion) thereby posing a threat to other trees in the urban forest, all possible action will be taken to effectively decrease the risk to other trees from the pest outbreak.
- An integrated approach to pest and disease management will be adopted that employs methods and materials that preserve and augment the ecosystem while facilitating permanent control of the pest.
- Advice and management programs will be sought from other agencies or pest and control regulators, such as State departments of environment and primary industries to ensure best practice approach is adopted for any pest outbreak.
- Trees will be removed when they are infected with an epidemic insect or disease for which the recommended control is not applicable and removal is the only remaining recommended means by which to prevent transmission.
- New tree planting will favour tree species that are known to be pest and disease resistant and suitable to local urban conditions.
- New tree planting will ensure that a diversity of species are planted to ensure Moreland's urban forest is adaptable and less vulnerable to pest and disease attack. If one species becomes susceptible to an epidemic, the whole urban forest will not be wiped out. A greater diversity of species provides greater stability and long-term resilience of the urban forest.

MAJOR ANIMAL PESTS

Moreland City Council recognises that possums, flying foxes and other native animals are protected species under the Wildlife Act 1975.

Common Brushtail & Ringtail Possums

In the event that a Council managed tree is showing signs of excessive damage from Possum-grazing, Council shall inspect the tree and determine a suitable course of action to further reduce grazing, such as the pruning, banding or as a last resort relocation.

Grey-headed Flying Fox

The Grey-headed Flying Fox is a state and nationally listed threatened species. They play an important role in forest ecosystem regeneration by pollinating plants and dispersing seeds. The impact on vegetation is generally localised and is typically off set by their valuable role in regeneration.

Rabbits

Rabbits (*Orytolagus cuniculus*) are one of Victoria's most destructive and problematic pest animals, causing environmental damage by:

- Destroying indigenous vegetation;
- Competing with native animals for food and habitat; and
- Causing erosion, soil loss, and creek and river bank destabilisation.

While considered less problematic in urban areas, effective rabbit control is still required under State legislation for all landowners to take measures to minimise impact and prevent spread. Council implements control measures in areas along our creeks

and waterways. More information is available from State agriculture authorities.

INSECT SPECIES

Elm Leaf Beetle

Elm Leaf Beetle (*Pyrrhalta luteola*) can be a serious pest for Moreland's Elm tree population. Repeated defoliation over successive seasons can weaken elms due to continual reduced photosynthesis capacity and can threby increase their susceptibility to other stresses and may ultimately contribute to the death of individual trees. Council will endeavour to control Elm-leaf Beetle infested trees on Council land using best practice integrated pest management practices.

Council has set up a database of Elm trees in parks and streetscapes. Damage predictions and treatment decisions will be based on survey data and the continual monitoring of trees and elm thickets in affected areas. Sample damage prediction assessments will be undertaken with survey results used in conjunction with degree-day method to determine the timing and focus of the proposed control methods.

Psyllids

Sap-sucking psyllids can cause significant damage to a wide variety of Eucalypt and Corymbia species. While damage can appear significant, it may not significantly impact the long-term health and aesthetics of an impacted tree. Psyllids play an important role in the ecosystem and are typically managed through natural predation from birds and other insects.

Council will determine whether treatment is appropriate for infected trees based upon the overall threat to the health of the tree and the significance of the tree.

Callistemon Sawfly larvae

Callistemon Sawfly (*Pterygophorus cinctus*) often has a presence in Moreland following a wet autumn and can rapidly strip most of the foliage from Bottlebrush trees.

Sawfly larvae look like a caterpillar and grow to around 25mm in length and are a bronzy green colour and have a distinctive elevated pointed tail. They are gregarious in nature and usually occur in groups.

Moreland City Council will not intervene where insect infestations are on private property or where the sawfly larvae are present but not in plague or large proportions. Sawfly infestations are part of a complex ecosystem and as such are an important part of the food chain for a number of fauna.

Where outbreaks occur with large numbers of the larvae on individual trees or in plague proportions and where repeated defoliation will threaten the survival of the tree, Council will instigate an insecticide stem injection program in the following spring to ensure that the next generation of the insect is kept in check to ensure that repeated defoliation of the tree will not occur. (most trees will survive the initial defoliation and regenerate in the spring once the insect overwinters)

Stem injection consist of the injection of a systemic insecticide into the truck of the tree which is taken up into the tree and leaves which in turn kill the predatory larvae for the next 3 years which is the residual life of the product.

The impact of Callistemon Sawfly

DISEASE OF TREES

Dutch Elm Disease

Dutch Elm Disease (*Ophiostoma ulmi*) is a devastating vascular-wilt disease that has wiped out most of the elms of Britain and North America and over half the elms of continental Europe. The discovery of the disease in New Zealand has dramatically increased the likelihood of it reaching Australia.

Elms are considered highly susceptible to Dutch Elm Disease for several reasons:

- The majority of Moreland's elms are European species and more vulnerable than Asian species
- The Elm Bark Beetle (*Scolytus multistriatus*) is the vector for Dutch Elm Disease. The fungal spore of *Ophiostoma ulmi* is carried on the Elm

Bark Bettle which is well established in Melbourne.
- Many of Moreland's Elms are planted in park or street avenues and likely to be root-grafted meaning that once one tree has been infected, the disease can spread quickly to all other trees in the avenue.
- Many of our elms are over mature and starting to senesce and thus more vulnerable to disease.
- The genetic variability of established Elms are low with many sourced from a few imported plants.

Palm Fusarium Wilt

Palm Fusarium Wilt (*Fusarium oxysporum f.sp. canariensis*) of Canary Island Palms is a significant threat to palm species, in particular to the Canary Island Date Palm (*Phoenix canariensis*) and to the Cotton and Dessert Fan Palms (*Washingtonia robusta* and *Washingtonia filifera*) - both of which are commonly found in Moreland.

Fusarium wilt is a true wilt disease from which plant decline and death is as a direct result of the loss of function of the water conducting cells within the plant. The general decline symptoms are similar to those caused by other root and stem diseases and include:

- Progressive frond death from oldest to newest in the canopy.
- One-sided leaflet death on a declining frond.
- A prominent brown strip on the rhachis base starting at the trunk and extending out a variable distance towards the frond tip
- Discoloured vascular bundles in the 'striped' fronds.

To date there is no control for the fungus. Management strategies are the only option available to limit the spread of the disease and include:

- Properly sample symptomatic palms and seek lab verification of this pathogen.
- Avoid scattering infested soil within or among rows of palms.
- Clean tools used in palm removal with bleach or rubbing alcohol.
- Fusarium wilt-affected palms should be carefully removed from the landscape.

Myrtle Rust

Myrtle Rust is a serious fungal disease (*Uredo rangelii*] that affects plant species in the Myrtaceae family, which dominates Moreland's urban forest and includes Eucalyptus (Gum Trees); Waterhousia and Syzigium (Lilypilys) and Callistemon (Bottlebrush).

Originating from South America, it was first detected in Victoria in 2011. Myrtle Rust is likely to infect plants in wet and humid conditions. Symptoms include:

- The appearance of bright yellow spores on new leaf growth.
- The development of purple/red lesions on stems of new growth.
- Eventual leaf-curl and death of new growth.

Over time, plants infected with Myrtle Rust loose vigour and can become susceptible to other pests and disease resulting in death.

Given the prominence of plants found in the Myrtaceae family in Australia, this disease is considered very serious and a high priority has been given to stop the spread of Myrtle Rust.

Myrtle Rust cannot be eradicated. It spreads prolifically due to the large number of spores the fungus produces. Spores are spread over long distances by wind and water.

As the diseases cannot be eradicated, control is the best means of minimising the impact of Myrtle Rust. Control measures include:

- Spraying with fungicide
- Removing and disposal of infected plants
- Using a diversity of plant families - minimising the reliance on Myrtaceae

The most effective control of Myrtle Rust will be at nurseries and plant production sites. Council staff will be diligent in ensuring that new tree stock is sourced from nurseries that practice Myrtle Rust control.

WOODY WEED MANAGEMENT

Some tree species are so successful at growing in a certain region that their benefits are outweighed by the competition they provide to more desirable species in the area, especially to indigenous species along our waterways.

Weeds, in this context, can be defined as plants that are growing in the 'wrong' place. Weeds may be causing damage to natural ecosystems or they could have the

potential to escape from their current environment into other environments.

There are two types of listed weeds:

1. Declared noxious weeds are those proclaimed under the Catchment and Land Protection Act 1994 are listed as state prohibited, regionally prohibited, regionally-controlled and controlled.
2. Environmental weeds are those that threaten the values of natural ecosystems and often outcompete them.

Moreland City Council will remove woody weed species where appropriate through the normal management of the Council's tree population. Such works will often be limited to, and prioritised along creeks, adjoining parks and areas of native vegetation where weed impacts are greater. Replacement planting will normally be considered where appropriate.

MISTLETOE

Mistletoe is most noticeably found on trees such as Plums (*Prunus* spp.), Pin Oaks (*Quercus palustris*), and Plane Tree (*Platanus* spp.). Mistletoes are partial parasites, taking up water and mineral salts from the host tree. The vast majority of mistletoe species have green leaves, and carry out photosynthesis normally.

While the effect upon tree health is often minor, Mistletoe growth can proliferate within an individual tree or group of trees. Unchecked, Mistletoe can eventually contribute to tree decline and contribute to widespread dispersal among trees on private and Council managed land.

Clumps of mistletoe are often regarded as detracting from the visual amenity of a tree. Mistletoe becomes noticeable on host trees during autumn and winter seasons. Accordingly, it is recommended that a systematic pruning program to remove Mistletoe from host trees occur during the late autumn to early spring season. Locating mistletoe clumps is also easier at this time of the year due to the autumn leaf-drop.

HERBICIDE POLICY

18. METHODS

DATA SETS

Table 26 provides the three main data sets used and the dates of collection for this Street Tree Planting Plan.

Table 26. Street tree data sets

Data Set	Date Collected	Number of Trees/Sites	Percentage of suspected population	Collector
iTree Eco Sample	2015-2016	4,769	8%	ENSPEC
Aim Area Inventory	2012	12,474	22%	ENSPEC
Street Tree Inventory	2012-2015	56,429	100%	Moreland Council
Total iTree Data	*2012 &*	*15,906**	*28%*	*ENSPEC*

*this number does not include duplicates or trees identified during the iTree ECO survey that are no longer present within streets

The Street Tree Inventory data only contained tree species and geographic location. Existing data that was checked during the iTree Eco sampling was amended as required to reflect changes in tree status. Table 27 highlights the status of trees incorporated within the 2015-2016 iTree Eco sample based inventory, and the estimated impact of these observations on the current Street Tree Inventory Data.

Table 27. Estimated street tree status based upon sample data

Status	2016 iTree Eco Status	2016 iTree Eco %	Estimated Status in 2012- 2015 Inventory Data Set
Abandoned	104	2.20%	1243
Dead	39	0.83%	466
Current	4441	94.03%	**53060**
Removed/Vacant	185	2.94%	1661

Tree data collected in 2015-2016 used a sample based inventory approach - details are provided in Reference Document 1. A total of 4769 trees were assessed, which represents 8.45% of the total street tree population.

The 2012 data was collected as part of the Moreland City Council Area Integrated Maintenance (AIM) program, and included data fields required for iTree Eco modelling. Only data for the following AIM areas was available: Brunswick 1; Brunswick 2; Coburg 1; Glenroy 3; Brunswick West 1; and Brunswick West 2. To verify the currency of this data, 1251 trees of existing data were audited (10.02% of dataset), and are included within the 2015-2016 sample based inventory. Existing data was checked and amended as required to reflect changes in tree status and condition - this included adding distances and directions to two additional buildings where present. The information collected on these trees was used to update the entire Moreland AIM program dataset to provide a more accurate representation of its current status and to facilitate a more accurate extrapolation across the entire street tree population.

The iTree data from the datasets above was used to extrapolate across the entire known street tree population. Data extrapolation compared trees that occurred within both the iTree sample and the 2012 Moreland AIM data sets to determine changes in tree growth (i.e. size). The average change in growth was approximately 7%. This 7% increase in growth was then applied to the entire 2012 Moreland AIM data set to make it more accurately reflect the current size of these trees. The average iTree Eco valuations from both data sets (iTree ECO and AIM) was then applied to the 2012-2016 Street Tree Inventory dataset based upon Genus. Differences in average valuations for the most common Genera were calculated so as to better represent the street tree population and their current iTree ECO values.

Table 2 and Figure 18 provide a summary of the urban forest functions and values extrapolated for the entire street tree population of Moreland City Council, based upon the iTree Eco sample and updated Moreland AIM dataset. Only tree species that represent at least 0.1% of the assessed tree population are included within summarised statistics, as anomalous large specimens can misrepresent urban forest structure, function and values. Figures discussing species composition and diversity used the 2012-2016 Street Tree Inventory Data.

iTREE ECO AND INVENTORY SAMPLING METHOD

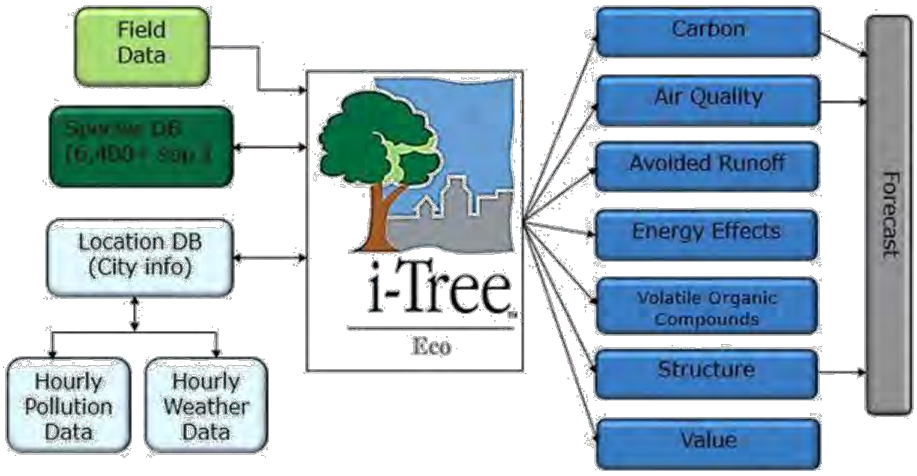
iTree Eco is a free flexible software application designed to use data collected in the field from single trees, complete inventories, or randomly located plots throughout a study area along with local hourly air pollution and meteorological data to quantify forest structure, environmental effects, and value to communities. All iTree Eco valuations were calculated with iTree Eco Version 5.1.13.

The results from i-Tree models are used to advance the understanding of tree and forest resources; improve urban forest policies, planning and management; provide data to support the potential inclusion of trees within environmental regulations; and determine how trees affect the environment and consequently enhance human health and environmental quality in urban and rural areas.

Tree measurements and field data are entered into the Eco application either by web form or by manual data entry, they are merged with local **pre-processed hourly weather** and **air pollution concentration data**. These data make it possible for the model to calculate structural and functional information using a series of scientific equations or algorithms. Further details about the methodology, calculations and values can be sourced at: **http://www.itreetools.org** and within technical documents in the **Resources – Archives** section.

145

Figure 65. Schematic of the use and function of iTree Eco.



Sample validation of 2012 iTree Eco data (12,474 trees) was undertaken. 200 tree samples, 1 in each completed AIM area, collected and used to validate the existing data. Additional data collected for City of Melbourne Valuation as well as the addition of 2 more buildings that recent versions of i-Tree Eco use for energy benefit calculations. Table 28 and 29 provide details of the start point for each sample area.

Table 28. iTree AIM areas (200 trees)

TREE	GENSPEC	AIM AREA	TREELOC	PROXIMITY	HOUSE	STREET	SUBURB
125538	Tristaniopsis laurina	BRUNSWICK 1	Cut-out	Front	390	Moreland Road	Brunswick West
67565	Ficus microcarpa var. Hillii	BRUNSWICK 2	Cut-out	Front	498	Lygon Street	Brunswick East
106803	Corymbia citriodora	COBURG 2	Nature Strip	Front	15	Strathearn Avenue	Coburg
125372	Pittosporum undulatum	GLENROY 3	Nature Strip	Front	57	New Road	Oak Park
69571	Acacia implexa	BRUNSWICK WEST 1	Nature Strip	Front	14	Henderson Street	Brunswick West
109027	Melaleuca styphelioides	BRUNSWICK WEST 2	Cut-out	Front	13	Fitzgibbon Avenue	Brunswick West

250 tree samples collected in the remaining 14 AIM areas (3500 trees) to validate the existing Council data and provide the basis for extrapolating the structural and iTree Eco analyses municipality-wide.

Table 29. Non iTree AIM areas (250 trees)

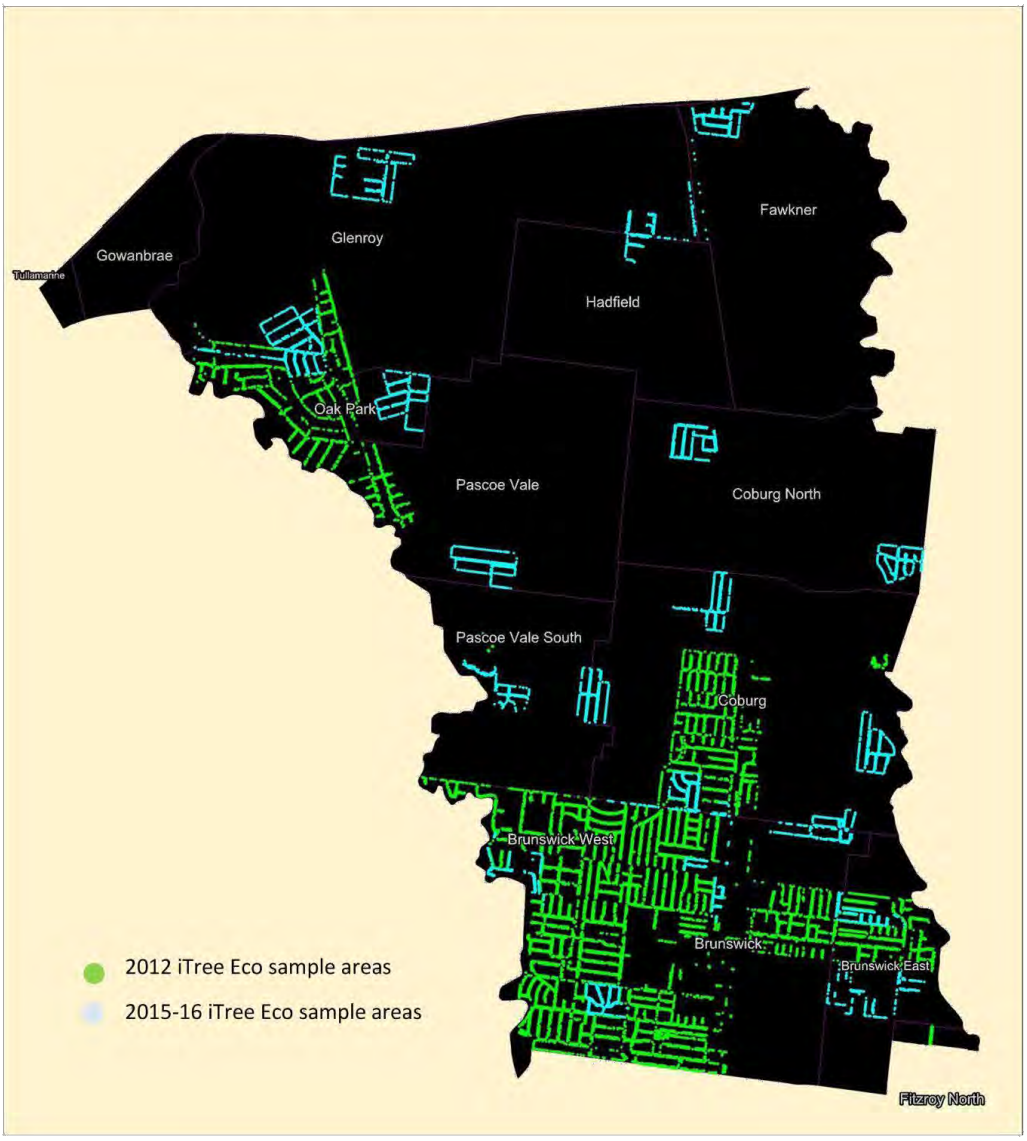
TREE	GENSPEC	AIM AREA	TREELOC	PROXIMITY	HOUSE	STREET	SUBURB
126393	Eucalyptus sp.	BRUNSWICK 3	Cut-out	Front	110	Victoria Street	Brunswick East
92161	Eucalyptus leucoxylon	COBURG / BRUNSWICK 1	Median Strip	Opposite	91	Davies Street	Brunswick
110361	Olea europaea	COBURG 1	Nature Strip	Front	15	Rose Street	Coburg
114173	Pyrus calleryana Chanticleer	COBURG 3	Nature Strip	Front	97	Nicholson Street	Coburg
104043	Lophostemon confertus	COBURG NORTH 1	Nature Strip	Front	12	Sharp Grove	Coburg North

146

118912	Eucalyptus leucoxylon	COBURG NORTH 2	Nature Strip	Side	22-40	Murray Road	Coburg North
119979	Malus ioensis	COBURG NORTH 3	Nature Strip	Front	13	Rolland Street	Coburg
65782	Callistemon viminalis	FAWKNER 1	Nature Strip	Front	4	Palmer Street	Fawkner
64961	Callistemon salignus	GLENROY 1	Nature Strip	Side	49	Snell Grove	Oak Park
121296	Eucalyptus mannifera Little Spotty	GLENROY 2	Nature Strip	Front	121	Widford Street	Glenroy
122831	Acacia implexa	GLENROY 4	Nature Strip	Front	3	Sim Crescent	Glenroy
93221	Eucalyptus leucoxylon	HADFIELD 1	Nature Strip	Front	60	Box Forest Road	Glenroy
73425	Agonis flexuosa	PASCOE VALE 1	Nature Strip	Side	1	Gallipoli Parade	Pascoe Vale South
117139	Ulmus sp.	PASCOE VALE 2	Median Strip	Opposite	2	Bolingbroke Street	Pascoe Vale

The location of each of the 4,769 iTree Eco sample sites and areas are highlighted blue for the 2015-2016 collection period while the 12,474 collection points from 2012 are highlighted green in Figure 66. Because the 2012 sample was not statistically significant, a more spatially representative sample was undertaken in 2015 and 2016.

Figure 66. iTree Eco Samples Tree Location Map



The general field data collection methodology was:

- Proceed to the designated start point as per the tables above.
- Starting with the highlighted tree, update the tree data and collect additional data when required.
- Ensure all existing data is correct and collect all other fields required. If there is a new tree not in the existing data, collect it using the same form.
- Proceed EAST or NORTH along the street, remaining on the same side. At intersections, turn LEFT. Do NOT cross into another AIM area. If you encounter an AIM boundary, municipal boundary, dead end or work back to your start point, cross the street and proceed in the OPPOSITE direction.

The data fields collected for each tree assessed within the iTree Eco stratified sample survey are provided in Table 30.

Table 30. Data fields used for iTree Ecosampling

Data Fields	Data Fields	Data Fields	Data Fields

148

MRLD ID	DBH3	Building Direction 3	GBM EDIT FLAG
MRLD Status	DBH4	Building Distance 3	GBM EDIT TIME
MRLD species	DBH5	CLE	X
Tree ID	DBH6	Tree Site	Y
AIM Area	DBHHT	Maturity	Genus Species
Street Address	TOTHT	Percent Crown Missing	COM aesthetics
Suburb	Live Top	Crown Dieback	COM species
STAT	Canopy Width EW	Life Expectancy	COM trunk
Genus Name	Canopy Width NS	Observation 1	COM growth
Species Name	Crown Base	General comment	COM pest
Cultivar	Field Land Use	Collection Date	COM structure
Common Name	Building Direction 1	Updated	COM life
Species	Building Distance 1	Crew	COM base
DBH1	Building Direction 2	iTree UFID	COM value
DBH2	Building Distance 2	Update UFID	COM canopy

149

CANOPY COVER DATA METHODS

Two different methods were adopted to analyse the canopy cover for Moreland.

First, iTree Canopy was used with randomly laid points (the number determined by the user) onto Google Earth imagery and the user then classifies what cover class each point falls upon - these points can then be exported and overlain onto historical aerial photography. The second approach, Kaspar method, emphasised the statistical significance of the results with random point analysis of canopy through different land classes (public and private realm and streetscapes) to better understand suburb level variation and understand future canopy potential.

Using iTree Canopy users can define any cover class they like and the program estimates results throughout the interpretation process. The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class, interpreted from an aerial image. The random points can be exported and overlain onto historical photography for comparative analysis.

A seven-hundred and fifty (750) point analysis was conducted on three sets of aerial photography: 2016, 2005, and 1989. Comparative analysis was also attempted on aerial photography from 1951; however available photography from this year only covered a small section of the municipality (Sydney Road from Brunswick to Coburg) - thus the data was deemed statistically invalid for comparative analysis with later years. Assessments of cover classes were made from the 2016, 2005, and 1989 aerial photography, and details are provided in Table 31.

Table 31. Canopy cover classes and status

Ground Cover Class	Description	1989	2005	2016	% Change 2005-2016
Park Tree	Tree in park	0.7%	1.6%	2.6%	63%
Road Reserve Tree	Tree in road reserve	0.6%	1.9%	2.4%	26%
Private Tree	Tree on private property	12.7%	12.1%	9.2%	-24%
Authority Tree	Tree on authority property	0.0%	0.0%	0.1%	
Private Plantable	Private Shrubs, lawn, garden etc.	16.3%	11.1%	14.0%	26%
Public Plantable	Council shrubs, lawn, garden etc.	12.9%	10.2%	9.1%	-11%
Water	Catchment, stream, waterway etc.	0.3%	0.1%	0.4%	300%
Buildings	House/structure	25.9%	29.0%	29.7%	2%
Public Non-Plantable	Council playground, ovals etc.	2.7%	2.7%	2.7%	0%
Private Non-Plantable	Private ovals, playgrounds etc.	6.3%	9.1%	5.7%	-37%
Private Hardscape	Private footpath, driveway etc.	8.9%	10.3%	11.2%	9%
Council Hardscape	Council footpath, bike path etc.	12.7%	11.9%	12.9%	8%

The average standard error for the cover classes was +2.7% for each year; however it is acknowledged that variability between data for each cover class is present.

Table 32 provides a summary of the calculated standard error for each cover class.

Table 32. iTree Canopy standard errors

Ground Cover Class	Standard Error 2016	2005	1989
Authority Tree	0.1%	0.0%	0.0%
Building	7.7%	7.3%	6.8%
Council Hardscape	4.1%	3.9%	4.2%
Park Tree	1.2%	1.0%	0.6%
Private Hardscape	3.7%	3.3%	3.0%
Private Non-Plantable	2.2%	3.2%	2.2%
Private Plantable	4.4%	3.9%	4.9%
Private Tree	3.2%	3.8%	3.9%
Public Non-Plantable	1.3%	1.4%	1.5%
Public Plantable	3.2%	3.5%	4.3%
Road Reserve Tree	1.2%	1.0%	0.3%
Water	0.3%	0.2%	0.2%

The Kaspar method of mapping urban forest canopy cover adopted simple, statistically and rigorous methods that allow Moreland to benchmark and track change in tree canopy over time by suburb. Tree canopy figures were based on high resolution aerial images from 2011 and 2016 using random sampling of 2000 points for each of eight selected suburbs. The results identify canopy cover change on different land-use types or tenures (public land, public streetscapes and private land) and why.

Change in tree canopy cover was calculated for each suburb through a simple random sample of 2000 points assessed through GIS software on remote imaging for 2011 and 2016. Each point was assessed as either one of four variables: Tree canopy cover (1) Shrub cover (2) Bare earth/ grass (3) or Hard surface (4) and were assessed as landing on either streetscape, private land or public space (Table 33). If change was recorded between 2011 and 2016 an additional assessment of the area was made to ascertain the cause of the loss. The data was then assessed statistically for significance and variation.

The results detect tree canopy change of <2% over five years to a 95% level of confidence. The standard errors for this mapping exercise are much lower (<1.1%) and therefore provide more reliable estimates compared to iTree Canopy (<6.8%).

Table 33. Distribution of by land-use areas for each suburb (SA2), 2011-2016

Suburb	Land-use	no. of points	% of SA2	SE %
Brunswick West				
	Street	554	27.7	1.0
	Private	1278	63.9	1.1
	Public	168	8.4	0.6
	Total	*2000*	*100*	*n/a*
Coburg North				
	Street	308	15.4	0.8
	Private	1294	64.7	1.1
	Public	398	19.9	0.9

151

	Total	*2000*	*100*	*n/a*
Fawkner				
	Street	386	19.3	0.9
	Private	1244	62.2	1.1
	Public	370	18.5	0.9
	Total	*2000*	*100*	*n/a*
Glenroy				
	Street	338	16.9	0.8
	Private	1176	58.8	1.1
	Public	486	24.3	1.0
	Total	*2000*	*100*	*n/a*
Hadfield				
	Street	307	15.4	0.8
	Private	870	43.5	1.1
	Public	823	41.2	1.1
	Total	*2000*	*100*	*n/a*
Brunswick East				
	Street	429	21.5	0.9
	Private	1279	63.6	1.1
	Public	299	15.0	0.8
	Total	*2000*	*100*	*n/a*
Coburg				
	Street	464	23.2	0.9
	Private	1272	65.6	1.1
	Public	299	11.2	0.7
	Total	*2000*	*100*	*n/a*
Pascoe Vale				
	Street	351	17.6	0.9
	Private	1451	72.6	1.0
	Public	198	9.9	0.7
	Total	*2000*	*100*	*n/a*

Table 34. Changes in hard surface area between 2011 and 2016 by land-use category, Moreland LGA

	Street		Private		Public		Total	
	2011	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**
Brunswick West								
% Cover	72.6	76.5	62.3	67.1	22.6	22.0	61.8	65.9
% se (+/-)	1.9	1.8	1.4	1.3	3.2	3.2	1.1	1.1
Change over time								
% difference		4.0		4.8		-0.6		4.1
% change		5.5		7.7		-2.6		6.6
p value[1]		*0.00*		*0.00*		*1.00*		*0.00*
Coburg North								
% Cover	75.0	74.4	66.3	68.3	17.8	18.3	58.0	59.3
% se (+/-)	2.5	2.5	1.3	1.3	1.9	1.9	1.1	1.1

Change over time								
% difference		-0.6		2.0		0.5		1.3
% change		-0.9		3.0		2.8		2.2
p value[1]		*0.88*		*0.05*		*0.88*		*0.11*
Fawkner								
% Cover	61.9	62.2	62.4	63.3	18.9	15.1	54.3	54.2
% se (+/-)	2.5	2.5	1.4	1.4	2.0	1.9	1.1	1.1
Change over time								
% difference		0.3		0.9		-3.8		-0.1
% change		0.4		1.4		-20.0		-0.2
p value[1]		*1.00*		*0.42*		*0.02*		*0.95*
Glenroy								
% Cover	63.9	64.8	53.4	57.4	18.7	20.2	46.8	49.6
% se (+/-)	2.6	2.6	1.5	1.4	1.8	1.8	1.1	1.1
Change over time								
% difference		0.9		4.0		1.4		2.9
% change		1.4		7.5		7.7		6.1
p value[1]		*0.74*		*0.00*		*0.31*		*0.00*
Hadfield								
% Cover	72.0	71.7	65.7	67.4	39.9	41.3	56.1	57.3
% se (+/-)	2.6	2.6	1.6	1.6	1.7	1.7	1.1	1.1
Change over time								
% difference		-0.3		1.6		1.5		1.3
% change		-0.5		2.4		3.7		2.2
p value[1]		*1.00*		*0.09*		*0.08*		*0.02*

Table 35. Land cover estimates by type including greenspace and hard surfaces for 5 suburbs, 2016

Cover estimates for each suburb by land-uses

Suburb	Land-use	Tree Cover	Shrub Cover	Grass/ Bare Ground	Hard Surface
Brunswick West					
	Street	11.4	0.5	11.6	76.5
	Private	14.8	5.9	12.3	67.1
	Public	24.4	2.4	51.2	22.0
	Total	*14.7*	*4.1*	*15.4*	*65.9*
Coburg North					
	Street	12.0	1.0	12.7	74.4
	Private	11.1	2.7	17.9	68.3
	Public	28.6	2.5	50.5	18.3
	Total	*14.8*	*2.4*	*23.6*	*59.3*
Fawkner					
	Street	13.0	1.0	23.8	62.2
	Private	10.3	5.3	21.1	63.3
	Public	12.4	5.9	66.5	15.1
	Total	*11.2*	*4.6*	*30.1*	*54.2*

153

Glenroy					
	Street	9.5	2.7	23.1	64.8
	Private	11.0	3.9	27.7	57.4
	Public	13.2	2.9	63.8	20.2
	Total	*11.3*	*3.5*	*35.7*	*49.6*
Hadfield					
	Street	7.2	2.9	18.2	71.7
	Private	7.6	5.3	19.8	67.4
	Public	19.0	2.2	37.5	41.3
	Total	*12.2*	*3.7*	*26.9*	*57.3*

Table 35 shows land cover by vegetation type for 5 suburbs to provide insight in to detailed changes in land use as well as identifying opportunities for vegetation. The same analysis was undertaken in 2011 and 2016 to assist with land use change over time. It is important to understand that canopy figures for vegetation type do not discriminate between quality, complexity and total canopy coverage. For example, it is possible to have under-storey, mid-storey and canopy cover rather than simply a binary rating for the site. The same rule applies to roads, footpaths and buildings. While Council trees over hanging private dwellings can have maintenance and liability risks, residents can have tree canopy that shades adjoining houses.

Statistical boundaries

Statistical boundaries for each suburb were SSC and SA2 polygons sourced from the ABS (ABS 2011).

Land-use types

Land-use areas were classified based on policy relevant clusters of area use: private, public or street (Table 36 below). Areas were aggregated using zoning data and polygons from the *Vicdata* planning database (Vicdata 2016). Land-use types included the following:

- *Streetscapes* including streets, roads, alleyways and nature strips and is mostly an area under the jurisdiction of local government or road management authorities (e.g. VicRoads);
- *Public areas* including aggregates of areas under local, state or federal government, for example parks, libraries, cemeteries and education facilities; and
- *Private* land-use comprised commercial, industrial, residential and other land use types.

Table 36. Land-use categories from *Vicdata* planning database used in the study

Land-use class	Zoning code	Zoning class description
Public	PC, PP, PU	Public Park, Education, Health and Community, Transport, Cemetery Crematorium, Local Government, Conservation Zone, Other public use or service area

Private	AC, AE, B, BM, C, CA, CC, CD, CL, D, DC, DD, DP, DZ, EA, EM, ER, ES, FO, FZ, GA, GR, GW, HO, IA, IN, IP, LD, LS, MA, MU, NC, NR, PA, PD, PZ, R, RA, RC, RF, RG, RL, RO, RU, RX, SB, SL, SM, SR, SU, TZ, UF, UG, UR, VP, WM	Commercial, Industrial, Residential, Other land-use types
Street	RD	Streets, Roads, Nature Strips

Aerial Images

Remote images were provided by Moreland City Council and were from two time periods 5 years apart: April 27, 2011 (time A) and February 11 2016 (time B).

Classification of a tree in imagery

The same sample was assessed for images for each time point (2011 and 2016). Each point in the SA2/SSC was manually assessed as falling under one of four variables: Tree Canopy Cover (1) Shrub Cover (2) Bare Earth/ Grass (3) and Hard surface (4) which was the same classification used for the 2013 Benchmarking Australia's Urban Tree Canopy report (Table 37).

Table 37. Classification of variables

Tree Canopy	Shrub Canopy	Grass/ Bare Earth	Hard Surface
Tree that is >2 meters	Plant that is <2 meters but not grass	o Agricultural pasture	o Buildings
o Any plant that looks like a tree from above	o Agricultural crops such as grape vines	o Residential lawns	o Roads
	o Bushland shrubs	o Cleared areas to the sides of roads and railway tracts o Golf Courses o School Ovals o Airports o Sports Fields o Cemeteries o Horse racing tracks o Lawn Bowls o Grass Tennis Courts o Industrial estates o Sites cleared for development o Dirt roads and walking tracks	o Footpaths o Train lines o Car parks o Water bodies o Sandy beaches o Rocky coastlines

Source: Jacobs 2013

Identifying trees from shrubs

The aim for the project was to classify trees with a canopy height of >2 metres. There is no definitive method to identify a tree from a shrub in an aerial image due to the 2D nature of the image (Rogers & Jaluzot 2015). However, similar to other research on canopy cover, shadows, growth over fences and buildings and other contextual information were used to help differentiate between trees and shrubs (Richardson & Moskal 2014). Due to these issues there may be a potential over classification of tree canopy due to the difficulty in discerning trees and shrubs.

Other potential sources for misclassification include excessive shadows resulting from the time of the day the

image was taken, user error and vegetation height. Vegetation height, coupled with the angle that the image was taken can potentially lead to image parallax errors where tall objects appear to lean and 'move' the point between the two time images (Nowak & Greenfield 2012). While it was not possible to correct parallax errors, it was assumed that these errors were randomly distributed and did not materially affect canopy estimates for this study.

Data Quality

An additional subsample for each time point (2011 and 2016) was reassessed to check for errors in coding.

Assessing the cause of canopy cover loss

Dichotomous matched-pair samples involve the use of the same simple random sample in a spatial area on different time points. This method enables an assessment of the cause of loss of canopy cover from time A (2011) to time B (2016). If a point was classed as Tree (1) in 2011 but then classed as Not Tree (2-4) in 2016 then an additional visual assessment of both aerial images around the point was done to identify the cause of the loss. A new variable was created to capture this with two values identifying the general cause of the canopy cover loss: construction or removal.

- *Construction* was identified as the cause if there was evident building activity in the surrounding area of canopy loss (for example renovation, a new building/pool);
- *Removal* was identified if there was not a direct identifiable cause of the canopy loss (for example tree pruning or tree removal)

Statistical tests

Greater sample size from the research (16000 points) increased the statistical power to identify with confidence any broad changes in canopy cover within the LGA. For more information on how the data was collected and assessed see Reference Document 1 Section 15 Methods.

Sample based methods invariably rely on sampling design and statistical inference to arrive at an estimate of total canopy cover. To measure the uncertainty in this estimate, a standard error is usually calculated. When comparing results between two samples, for example between two points in time such as in this report, a significance test should be undertaken which indicates the probability that the difference observed is a statistical artefact. For the purposes of this study a standard error was calculated for the main sample statistics. To test for significance between the two time points a McNemar test was used.

REFERENCE DOCUMENT 2 - TREE PROTECTION GUIDE

Trees and vegetation make an important contribution to the urban environment as well as in delivering essential environmental, economic and social benefits to the community. Vegetation can also be important in defining and contributing to the character of Moreland.

Often trees and vegetation are removed or incrementally depleted if sites are redeveloped or through general maintenance of a property. These incremental changes can have an impact on the appearance of an area and result in the loss of significant vegetation. West Australia's Planning Commission (2013) recognised this conundrum:

Expected increases in the density of urban form will increasingly affect mature trees in yards and verges. Loss of tree canopy is an incremental process which often goes unnoticed until it is too late to undertake preventative actions.

Despite this challenge, many local governments have committed themselves to increasing canopy cover. Perth is expecting a 50% increase in urban infill development and has committed itself to increasing urban forest canopy by 34%. The City of Melbourne aims to increase tree canopy from 22% to 40% by 2040 while Sydney has committed to a more modest target from 15.5% to 23.3% by 2030.

Various measures can be used to protect vegetation in urban areas. Moreland's planning scheme and local law provide a level of protection to significant or important vegetation but the canopy change results reveal that changes are required to ensure Moreland can increase overall canopy cover.

The Moreland Planning Scheme (Clause 21.04) currently includes the reference document, *Moreland Landscape Guidelines 2009*. This document should be reviewed to ensure it is an effective guide to encourage appropriate canopy tree planting but also provides greater protection.

Broader amendments to the Planning Scheme should be considered as part of a Working Group. Much of the background work behind this Strategy can be used as the evidence base to inform any potential amendments. Such changes to the Planning Scheme however, will require at least three to five years and would involve the following steps and timeframes:

- **Year 1**
  Ensure the Urban Forest Strategy provides sufficient strategic justification for a future amendment that could be undertaken by Council and peer reviewed. A Working Group will need to consider the cost-benefit of a range of mechanisms (Planning Scheme, Local Law, Public Education etc.) and what each seeks to achieve.
- **Year 2**
  Any amendments to the Planning Scheme need to be authorised with a public exhibition period involving consultation and a Panel hearing.
- **Year 3**
  Council would then consider the Panel Report and prepare a submission for amendment to the Victorian Planning Minister.

Each of these tasks will have cost and resourcing implications for Council and will need to be endorsed before proceeding.

Council is currently seeking variations to the residential zones that require minimum amounts of private open space. These variations will provide a useful foundation to build upon any possible future amendments.

Key to the protection of trees within the public and private realm are policies, strategies and local laws within Council that guide decisions for street tree planting projects. However, it has been identified that there are gaps within current Moreland City Council policies and local laws to facilitate the protection of existing, and future trees, within the private and public realm. Some of the existing relevant strategies and policies are:

- Council Plan
- Climate Action Plan
- Municipal Strategic Statement
- Environmental Significance Overlays
  - Schedule 1 – Merri Creek and Environs
  - Schedule 2 - Moonee Ponds Creek and Environs
- Heritage Overlays
- ESD Local Planning Policy
- Health and Wellbeing Plan
- Moreland City Council Landscape Citations
- Moreland Open Space Strategy
- Moreland Municipal Public Health and Wellbeing Plan

- Moreland Water Map
- Municipal Strategic Statement
- Zero Carbon Evolution
- Urban Heat Island Action Plan

The current planning scheme incorporates mechanisms to ensure the protection of existing vegetation as well as the need to retain significant vegetation for private and public developments within the municipality. When trees cannot be retained then it requires that new developments facilitate the incorporation of significant canopy trees within their design.

In addition, the tree protection guidelines outlined in Australian Standard AS 4970 Protection of Trees on Development Sites is standard in all planning and development documentation. Monitoring and enforcement requires further attention with additional resources allocated to development sites with additional Open Space officers as authorised officers. Such a program could be self-funded.

Enforcement of relevant Australian Standards such as AS4970 -2009 (Protection of Trees on Development Sites); AS4373-2009 Pruning Amenity Trees; and AS2303 - Selecting Trees for Landscape Use is paramount to maintaining and improving the contribution of street, park and private trees.

The canopy analysis (see Urban Forest Strategy Section 6) reveals that without a shift towards larger canopy trees and the reversal of a steady loss of private realm vegetation, Moreland is likely to struggle to achieve a net gain in canopy coverage. The introduction of new policies to encourage private realm tree planting and increase protection of existing trees could offset the losses from urban consolidation and construction activities.

The protection of trees and vegetation is important to retaining our city's character and environment. Trees grow in a delicate balance with their environment and any changes to that balance must be minimised if the urban forest is to remain healthy state and fulfil its potential. There are two critical considerations to protecting trees. Firstly, ensuring they have access to adequate soil, water and light. Secondly, that any possible damage is avoided. It is rarely possible to repair stressed and injured trees, so damage needs to be avoided during all stages of development and construction. It is for these reasons that the city will retain all trees where it can and where it is appropriate.

1. TREE REMOVAL

Our urban forest holds varying values for different people, depending on the context in which they are viewed. Through consultation with the community the majority of people see the urban forest as beneficial while others may see some aspects as creating a nuisance. This strategy supports the belief that the overall positive values of vegetation outweigh the disadvantages when considered in the appropriate context. For example, it is recognised that each tree exists in its own right and has a different and individual place in the park or street. Of equal importance is its role in relation to the rest of the landscape and the City as a community asset.

Trees have a natural life span and it is necessary to plan for their eventual removal and replacement. As trees age they require more and more management to maintain them in a safe and attractive condition. Consequently, a difficult decision has to be made about how to manage mature trees and plantings, including how, when and over what period of time to replace old or declining trees.

Useful life expectancy (ULE) is not the biological life expectancy of a given tree species. ULE relates to how long a tree can be usefully retained within a given site with consideration to the trees condition, aesthetics, management inputs, and risk management.

Fortunately, Moreland's urban forest is relatively young and healthy. Around 3% of the street tree population is estimated life expectancy of less than 10 years. Combined with park trees this equates to nearly 2,000 trees reaching the end of their useful life every year. This low abundance of dying trees (less than 10 years life expectancy) reflects an active management program that is removing dead and severely declining trees, and the greater abundance of healthy trees (greater than 30 years life expectancy) indicates an active program of tree replacement, and infill of vacant plantings.

In such circumstances, tree removal may be necessary. By acknowledging circumstances where removal is appropriate, tree replacement can be planned ensuring the enhancement of the landscape or streetscape. Reasons for removing a tree may include:

- The tree is damaged, post-mature, and diseased or in decline and no further remedial techniques are appropriate.
- The tree is causing damage to property, public utilities and the cost of ongoing remedial works becomes uneconomical, i.e. the cost of the perceived ongoing repairs outweighs the value of the tree and there is no reasonable alternative to solve the problem.
- The tree is causing immediate safety hazard to the public or poses a serious health risk.
- The trees are not significant and have been indicated to be removed on a streetscape plan or works program approved by Council.
- Where the constraints of powerlines have been removed and a tree is of a species or has been pruned in such a manner that the development of an adequate canopy is unlikely.
- Where the constraints of powerlines have been removed and the tree(s) on the powerline side of the street are such that there is a significantly unbalanced streetscape.
- Where all re-design options have been exhausted by developers and Council approve removal. In these situations, the developer shall meet all the costs of the existing tree's amenity valuation, removal, replacement and establishment costs of new trees. The replacement trees being of an appropriate size and species within the development area or as close to the development as practical.
- Inappropriate planting by resident.
- The tree poses a serious threat to ecology and evidence of dispersal of its seeds or vegetative parts.

Where trees are proposed to be removed from a park or street then residents will be notified either through the erection of a sign in the park and/or a letter sent to adjoining households. The notification will outline the timeframe for works, an explanation for the proposed removal and a key contact.

Requests by the community for the replacement of street trees that have died or been removed are assessed by Council in the context of available funding, the planting plan, landscape requirements, environmental constraints, site and seasonal conditions, availability of stock and community expectations.

For major streetscape tree removals or renewals a concept plan will be prepared in accordance with this policy. The proposal will be made available to the public for a specified period for comment, which may include a public meeting. The level of consultation will be based on the scale of the project. If the proposal is of high level significance a notice of the proposal, comment period and any public meeting will be publicised so that all interested residents have a chance to comment. Residents in the immediate vicinity will be notified in writing. Following the public consultation phase, the proposal will be re-submitted to Council, detailing comments and/or modifications submitted through the process.

Any tree removals need to be updated in the tree asset management system.

Significant reductions of mature trees would not be generally considered as good practice or acceptable as this would have a negative impact on social, cultural, environmental and economic values. It is also not good practice to artificially keep trees in a position that they are clearly unsuitable for, as this can lead to infrastructure damage, reduced tree health or conflict in the community.

Where the upgrade involves the large-scale removal of mature trees, a staged removal and replacement program will be implemented. Trees identified by staff as post mature, diseased, causing damage to property or public utilities or considered an immediate safety hazard will be removed first. The remainder of the trees would be removed over subsequent years based on an agreed timetable. Council would determine the time taken for replacement based on the scale of the upgrade.

If a resident requests the removal of a street tree and the removal is declined it is then possible for the resident to request a review of the decision. The applicant is then required to pay for an independent Arborist Report from one of Council's Panel of Arborist. The report needs to be consistent with the principles of the Tree Protection Guide. If the report deems the tree is to be removed or alternative action, then this will be

undertaken at Council cost. If the report deems the tree to be retained the tree will remain. Contact Council for the list of consulting arborists on Council's Arborist Panel.

2. PARK TREE PROGRAM

Moreland City Council actively plant trees as part of play space renewal projects. For example, the 2016 upgrade of Kirkdale Park play space resulted in the planting of over 70 trees. In addition, Council's revegetation program and community planting days along its creeks and waterways result in additional plantings of around 600-650 annually. However, Moreland City Council currently lacks a dedicated annual park tree program. Instead, trees are planted on a 1:1 ratio following hazard tree removals. Moreover, Council capital projects and private developments have resulted in an overall reduction in the number of trees. And yet, the tree canopy mapping has highlighted significant opportunities for increasing tree planting in Moreland's parks. At the same time, Moreland Play and Open Space Strategies highlight the importance of shade provision for Moreland's play spaces. A 2016 audit of play spaces found almost half lacked adequate natural shade. It is therefore a priority action of this Strategy for Council to fund a park tree planting program with a priority focus on play spaces, shared pathways, and access points to and through parks.

The following reasons do not justify tree or vegetation removal:

- Tree litter / Leaf fall/seed and gum drop
- To provide vistas
- Tree is considered too big or too old
- Tree growing over property
- Residents perception of risk
- Allergies
- Trees blocking light into resident's property
- Resident requests an alternative species
- A perceived danger that a tree might fall in a storm
- A desire to re-landscape
- Property alterations requiring the relocation of the crossover
- Swimming pool installation and problems with roots and/or falling leaves
- Shading of lawns, pools etc by nature strip trees.
- Solar access for solar panels
- Animal droppings from fauna roosting in trees
- For surface root growth that increases mowing height

The preservation of existing trees is of prime importance and practical techniques are to be used to maintain the health of trees. Legal advice is required to clarify clear areas of responsibility for Council's tree maintenance program.

3. TREE REMOVAL AND ALLERGIES

Plant allergies, hay fever and asthma attacks impact upon the quality of life of many people in the community. Airborne allergies are known as allergic rhinitis and are often caused by pollen from grasses and other plants particularly during spring. Such causes are however complex and seasonal and daily levels of airborne pollen are influenced by a range of natural factor such as weather, wind direction, pollution, land cover and ecology.

Trees are rarely a significant cause of such allergies as most street trees have a limited flowering seasons during which they are likely to cause any problems. As a general rule, street trees will not be removed on the grounds of allergic reactions. Any residents concerned about allergies should undertake allergy testing with a qualified medical practitioner to identify its cause. Council requires a medical certificate identifying the cause of the allergy before any further consideration will be given.

4. SIGNIFICANT TREES AND VEGETATION

It is recommended that a working group be established to consider whether Moreland should develop a register of significant trees and vegetation. This register could potentially inform nomination for protection through an amendment to the Moreland Planning Scheme or a revision to the Local Law. The protection of significant trees and vegetation in the public and private realm could mean that to significantly prune, lop or destroy a tree or vegetation listed on the Significant Tree and Vegetation Register would require a planning permit.

A Significant Tree and Vegetation Register could help ensure that unique, historical, rare and environmentally important trees and vegetation are protected and not removed or lopped without Council's approval.
The register could cover trees and vegetation located on private properties, as well as those in our streets, local parks, gardens and other public land across the municipality.
The definition of a significant tree was adopted in the 2012 Moreland Street Landscape Strategy and may prove to be a useful guide for the private realm. A tree is considered significant if it is taller than 6 metres or has a trunk that is 300mm or wider measured 1.2 metres above ground level or it is listed on Council's Significant Tree Register.

Criteria

Significant streets have special qualities and make a contribution to the amenity of the area and will not be removed unless they are dead, diseased, dying or dangerous. Generally these trees are mature, large in size, of good health and form and provide landscape continuity and high aesthetic, cultural and physical amenity values. Significant trees are defined as having one or more of the following noteworthy features:

- Trees that are taller than 6 metres or have a trunk diameter of at least 300mm measured 1.2 metres from the ground
- A species or variety of tree that is rare in cultivation, or unusual in Moreland
- A tree of outstanding aesthetic significance
- A tree that forms part of an avenue of consistent size, form and variety
- A tree that contributes to a closed canopy over a street or pedestrian path
- A tree that was once contemporary with remaining heritage listed buildings
- A tree that is an outstanding example of the species or variety
- Trees that listed of heritage value
- A tree that commemorates a particular occasion, event or activities
- A remnant indigenous species tree
- Any tree associated with aboriginal activities
- A large, healthy tree or collection of trees in a high profile location
- Trees that may indicate or provide evidence of a previous use of the land
- Trees that provide habitat for native fauna as evidenced by the presence of a nest or a hollow or from a confirmed sighting of native fauna species that is unusual or rare
- Trees on any Council significance register (including landscape citations) or National Trust Register

Moreland has around 4,500 significant trees across the municipality including this Brunswick street tree.

5. PROTECTION OF TREES DURING DEVELOPMENT

The protection of existing trees during development and construction works is important to avoid a decline in Moreland's existing tree population.

If a Council tree were to be removed through development, or malicious damage, then Moreland City Council uses a monetary value to quantify the amenity loss to the community. This cost, or loss of amenity, can then be passed on to the landowner or the party responsible for the removal, or malicious damage of the tree. In addition, the cost of removing the tree, replacing it and establishing the tree will also be charged.

Amenity and environmental values are sought for a tree if it is to be removed for the following reasons:

- As a result of a development application for removal.
- Vehicle cross-over request.
- Unauthorised tree removal.
- Tree is damaged structurally or aesthetically beyond that which the tree can no longer be retained.

Moreland City Council uses the established tree evaluation formula developed by the City of Melbourne. The formula used is:

Value (V) = Basic Value ($) x Species (S) x Aesthetic (A) x Locality (L) x Condition (C)

The environmental value of the tree is measured using the iTree Eco tool. iTree Eco provides a dollar value for the environmental benefits of trees including current environmental functions, longevity and overall performance of the forest

The combination of these methods identifies that there is more to a tree than just its basic value. The other factors are equally important in their value to the community, to the environment and to the general amenity of the municipality.

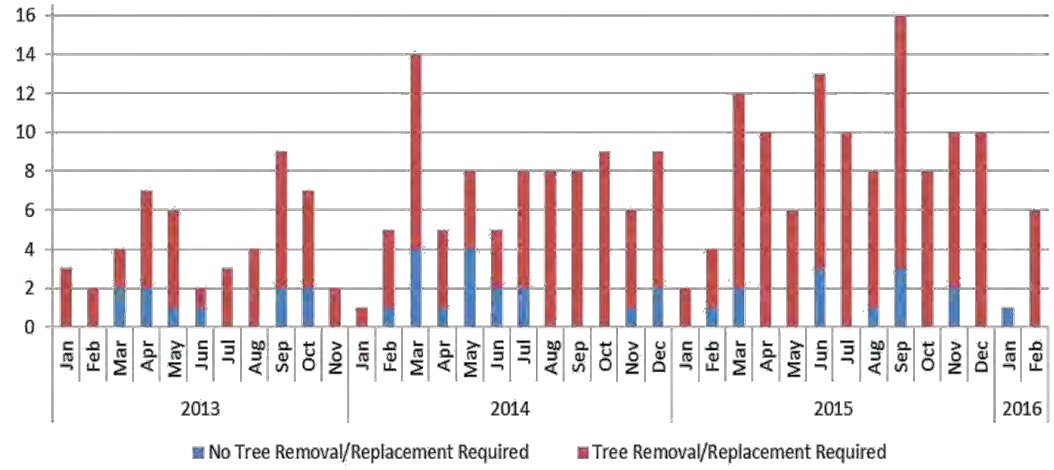
Significant Kurrajong species located at 564-566 Moreland Road that was protected through the development application with the project named after the tree.

CROSS OVERS

There has been a steady increase in applications from residents and developers to remove street trees to make way for vehicle crossovers in recent years (Figure 67). In 2013 there were 49 tree assessments undertaken followed by 86 in 2014 and 109 in 2015 Council approvals have increased from 80% of applications in 2013 and 2014 to 89% in 2015. As a result, 97 street trees were removed in 2015. The impact of approved tree removals arising from crossover applications has contributed to the declining street tree canopy cover in Pascoe Vale and Glenroy. Two replacement trees are planted for every tree removed to ensure that over time there is no reduction in canopy.

Council will generally not approve the removal of a significant tree to facilitate a crossover and will also work with Applicants towards alternative building designs to accommodate street trees. If approval is granted to remove a street tree, then the Applicant will first have to agree to pay the tree's amenity and environmental value together with the removal, replacement and establishment costs for the tree.

Figure 67. Vehicle crossing tree inspection and results, February 2013 – February 2016



6. COMPETING INFRASTRUCTURE AND SERVICES

To achieve the vision of maximising the urban forest in Moreland, adequate space needs to be allocated for trees and vegetation, both above and below ground. Trees, hard infrastructure and services often compete for the limited space available in streets. The following services constrain the location, number and size of the urban forest:

- Power Line Clearance Regulations
- On street parking
- Vehicle Clear Zone Guidelines
- National Broadband Network
- Installation of solar panels (issues with access to light)
- Street lighting
- Bicycle lanes
- Vehicle cross overs

Reference Document 2 includes a comprehensive list of clearance guidelines. If these clearances were strictly followed then it is likely that Moreland would lose half of its tree population. It is therefore necessary to maintain a balanced perspective that ensures community safety while remaining proactive in the protection of Moreland's street tree population. In considering retrofits and installation of new infrastructure a careful assessment of existing vegetation and opportunities for new trees should be undertaken.

The selection of appropriate species should also be considered. For example, a simple solution to conflict between effective street lighting and the shadows cast by trees is to encourage the planting of deciduous tree species around intersection. Deciduous trees will lose their leaves during winter and thus improve lighting when there is greatest need. Such plantings can therefore achieve both functional and design needs.

REFERENCE DOCUMENT 3 - MORELAND HABITAT STREETS

166

REFERENCE DOCUMENT 4 – NATURE STRIP GUIDELINES

INTRODUCTION

Nature strips contribute to the character of our neighbourhood and streetscapes. These guidelines outline the benefits of our city's nature strips and are intended to offer information on suitable plantings and their maintenance to ensure they remain a safe and attractive space.

Nature strips are the areas of public land between the private property boundary and the kerb and exclude the paved footpath area. It is the responsibility of residents to maintain the nature strip abutting their home. This typically involves regular mowing of grass, weeding and picking up litter, however, Council would like to encourage residents to consider alternative planting approaches that enrich biodiversity and social connectivity.

With the exception of our street tree program, Council does not undertake any renovation or maintenance (including mowing and watering) of nature strips unless the condition of the nature strip is considered to pose a hazard.

BENEFITS OF NATURE STRIPS

Vegetated nature strips provide a range of benefits to the community and the environment. Nature strips can:

- absorb rainwater and reduce stormwater runoff;
- provide a choice for residents unable to maintain turf;
- help to cool the surrounding area (transpiration by plants cools the air);
- complement the natural settings of the neighbourhood such as street trees and residential gardens;
- provide fauna habitat;
- visually soften the effect of the harder surfaces of road, footpath and driveway paving, fences and buildings;
- provide a valuable opportunity to interact with nature;
- improve social connections in the neighbourhood; and,
- where appropriate, can provide some opportunities for food production.

Moreland City Council encourages the following nature strip treatment:

- Low growing plant species below 0.5m;
- Warm season/drought tolerant grasses, such as Couch/Fescue, Buffalo or Kikuyu. These are hard wearing and require up to 60 per cent less watering; and
- Mulch – organic barks or inorganic gravel like Tuscan toppings or granitic sand.

ALTERNATIVE VEGETATION TO TURF GRASS

Moreland City Council supports the beautification of nature strips with alternative plants to turf grass. Allowing residents to plant out their nature strips can foster a sense of ownership within the local community. The use of indigenous plants can enhance biodiversity and provide habitat for local insects and birds. This type of planting is particularly beneficial in areas close to local waterways and along nature corridors. The maintenance requirements of a well-designed ground cover planting and mulch treatment can be less than traditional grassed nature strip plantings.

Alternatives may also include productive gardens and no-dig gardens. Health risks from contaminants and public safety impacts as outlined below are particularly important with these plantings.

For more useful advice on nature strip planting, visit Brunswick Communities for Nature: https://brunswickc4n.wordpress.com/

DESIGN GUIDELINES

Safety and access

Nature strip landscaping works must maintain adequate clearance, accessibility and visibility for pedestrian, bicycle and vehicular traffic when using, entering or exiting an intersection or driveway or footpath. Council will require that any works considered hazardous be removed and made safe.

To ensure the nature strip planting is safe for all road users and does not inhibit access:

- Call Dial Before You Dig (DBYD) to obtain free information about underground services;
- Maintain vegetation below a height of 0.5 metres to ensure adequate sight lines. Medium to large shrubs and trees should not be planted;
- Allow sufficient space so that people can access the street from the footpath and can open a car door

and easily get into and out of a car (at least 300mm);
- Ensure safe, level heights are maintained between the naturestrip and footpath and kerb
- Hard landscaping elements, such as rocks and pavers, garden edging and planter boxes, are not encouraged because they can become safety hazards; and
- Retain some level ground space for hard rubbish collection, garbage, recycling and green waste bins.

Plant selection

The following are important considerations when selecting plants for nature strip beautification:

- Discuss your plans with your neighbours so they understand why you are undertaking the works;
- Plants considered to be environmental weeds must not be planted;
- Plants must be low growing (below 0.5m within 1.5m of driveways or intersections) to avoid any traffic sighting problems;
- Indigenous plants can enhance biodiversity and are more likely to provide habitat for local insects and birds;
- Select plants that are able to survive with natural rainfall. Current water restrictions should be followed and irrigation systems are not to be installed; and
- Effective ground cover plants can compete with weeds and withstand occasional pedestrian traffic.

If plants are grown to be eaten, the nature strip soil should be tested for contaminants such as lead and any other potential health risks understood. Fruiting crops are better than root crops or leafy vegetables. Building the soil up over time is important through the addition of compost and organic matter and will improve soil health. Please note that nature strip are accessible to everyone and nothing can be enforced to stop the public from helping themselves to what is grown there.

SUGGESTED PLANTS FOR NATURE STRIPS

PLANT TYPE	BOTANICAL NAME OF PLANTS	COMMON NAME	SUGGESTED DENSITY (PLANTS/M2)
Grass and tussock plants	***Dianella longifolia***	**Pale Flax Lily**	**4**
	Dianella revolute	Spreading Flax Lily	9
	Lomandra longifolia	Spiny-headed Mat-rush	4
	Lomandra filiformis	Wattle Mat-rush	9
	Themeda triandra	Kangaroo Grass	9
	Poa labillardieri	Common Tussock Grass	4
	Poa morrissii	Silky Tussock Grass	9
Lawn plants	*Microlaena stipoides*	Weeping Grass	16
	Dichondra repens	Kidney weed	16
	Austrodanthonia geniculata	Kneed Wallaby Grass	16
Ground covers	*Myoporum parvifolium*	Creeping Boobialla	4
	Einadia nutans subsp. *nutans*	Nodding Saltbush	4
Wildflowers	*Arthropodium strictum*	Chocolate Lily	16
	Brachyscome multifidi	Cut-leaf Daisy	9
	Bracteantha viscosa	Sticky Everlasting	9
	Chrysocephalum apiculatum	Common Everlasting	9
	Kennedia prostrata	Running Postman	4
	Linum marginale	Native Flax	9
	Pelargonium austral	Austral Storks Bill	16
	Teucrium racemosum	Grey Germander	4
	Wahlenbergia communis	Tufted Bluebell	16

168

PREPARATION

It is recommended that the top 50mm of turf and soil is scalped or removed prior to any planting. A good option is to then lay biodegradable weed matting, which is an effective means of reducing weed growth or the return of the turf. A mulch layer will help maintain soil moisture and assist with additional weed control. The mulch material selected must be stable under foot and remain contained within the nature strip. Recommended treatments include composted organic mulch, pine bark mulch, recycled wood chip mulch and granitic sand. Council provides a free, self-serve tree mulch service from its South Street Hadfield depot.

CONSTRUCTION

Before starting any works, call 'Dial Before You Dig' or visit the website www.1100.com.au, to find out about pipes and cabling under your nature strip. Changes to nature strip levels that might interfere with drainage will not be permitted.

Cultivation will alleviate any soil compaction and improve plant growth and increase the infiltration of rainwater. Avoid cultivating under the canopy of existing trees as this activity may cut their roots and impact on their health.

No staking of plants or any net covering of plants is permissible as nature strips are in the public domain and these could create a hazard.

MAINTENANCE CONSIDERATIONS

- Nature strip surface levels, including mulch, adjoining the footpath and kerb to 300mm should be maintained within 40mm height relative to the level of the footpath or kerb.
- Plant material must be maintained within the area of the nature strip.
- Residents are to keep nature strips free of litter.
- Dead plants, seed heads and weeds should be removed regularly to keep the site tidy (this is particularly critical with productive gardens to remove harbours for pests and diseases and stop potential seed dispersal).

PLANNING

A few basic planning steps are helpful before you start planting up your nature strip.

- Talk to your neighbours to explain what you are planning to do and ask if they are interested or have any advice.
- Walk around your neighbourhood learning what plants are successful in growing in similar conditions to your nature strip.
- Get a copy of Council's Sustainable Gardening booklet or visit our website: http://www.moreland.vic.gov.au/environment-bins/environment/sustainable-gardening/
- Try drawing up a simple sketch that details the site including:
- Property boundaries
- Footpath and driveways
- Existing street tree
- Proposed planting
- Schedule of plant species and densities (i.e. what plants and how many will be planted per m^2)

IMPORTANT CONSIDERATIONS

While the cost of establishment, maintenance and renewal of the planting is borne by the resident or landowner, Council hopes this guide will help save you both time and money.

Council and service authorities reserve the right to access existing and future infrastructure assets that may be located in and around your nature strip. Services, such as gas, power, communications, stormwater, sewer and water are often located in the nature strip, so be aware that your beautified vegetation could be dug up with little or no warning. While service authorities and Council will reinstate the nature strip to a neat finish only, no plants will be replaced, following any disturbance resulting from access works. Additional costs incurred to reinstate the planting will be borne by the resident or landowner.

Residents will be required by Council to remove any inappropriate or inadequately maintained nature strip landscaping.

Council has the right to remove any landscape considered inappropriate based upon a Council Safety Audit.

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