

# Maungakiekie-Tāmaki Local Board Ngahere Analysis Update 2021

Canopy cover changes with the  
2013 to 2016/2018 LiDAR data

Urban Ngahere Strategy 2019  
Knowing Programme



## A summary of the urban environment in Maungakiekie-Tāmaki

Approximately

**83,000**  
residents

Only one area, One Tree Hill, with more than **20%** canopy cover

Nearly  
**3,700**  
hectares of land, with

**71%**  
in urban development

**1.8%** of original indigenous vegetation cover remaining

**516**

hectares of parks, including:

- Cornwall Park and the volcanic cones Maungakiekie / One Tree Hill
- Maungarei / Mt Wellington
- Ōtāhuhu / Mt Richmond

**1%** of canopy cover more than **30 metres** tall

**59%** of canopy cover with no statutory protection

Average canopy cover of

**12%**

across local board, including canopy cover of:

<b>23%</b> on public parkland	<b>12%</b> on road reserves	<b>11%</b> on other public land	<b>9%</b> on private land
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New zoning under Auckland Unitary Plan includes Mixed Housing Urban, Terrace Housing and Apartment Buildings

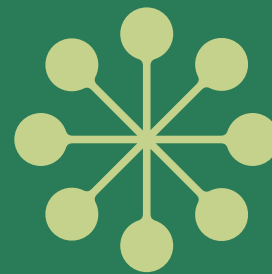
409 ha of urban forest in 2013,  
**increasing to 422 ha in 2016/2018**

**105 parks**  
and **20 playgrounds**

**51** hectares of Significant Ecological Area

**780**  
Notable Tree records

More than **45%** of total canopy cover on private land



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Maungakiekie-Tāmaki Local Board

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# 1.0 Preface

Tāmaki-Makaurau / Auckland is New Zealand’s largest city, and plantings of exotic and native trees have taken place as the region has developed. Early Māori settlers would have planted trees such as karaka, pūriri and tōtara to indicate a special place or to mark a celebration, while European settlers planted trees that were familiar and provided a sense of place. London Plane, English Oak, and European Lime trees were some of the earliest recorded plantings in Auckland. Settlers arriving from around the world commenced the history of Auckland’s diverse and unique tree cover.

When European settlers arrived to Tāmaki-Makaurau / Auckland, the gullies of the isthmus were filled with raupō, edged with a varied growth of sedges and other moisture loving plants; and slopes of gullies covered with karamu and cabbage trees. By the late nineteenth century, much of the Auckland area was under cultivation with a large number of introduced plants. Along with residential

development commencing in the mid-20th century, these actions have now reduced indigenous forest cover within the Maungakiekie-Tāmaki Local Board to small fragments, primarily in local reserves.

The Maungakiekie-Tāmaki Local Board has provided locally driven initiatives funding to Auckland Council’s Urban Forest Principal Advisor Urban Ngahere (Forest) in the Parks, Sports and Recreation Department to develop an analysis of the tree cover in its area of responsibility. This update report is the result of a programme of work by Auckland Council involving detailed analysis of urban forest cover on public and private land, aiming to identify opportunities to nurture, grow and protect urban trees in the local board area. The analysis work is directed by the Auckland Council’s Urban Ngahere (Forest) Strategy 2019, which has 18 key objectives to help Council and local boards to deliver a healthy ngahere for a flourishing future.





## 2.0 Introduction

### 2.1 Maungakiekie-Tāmaki Local Board

The Maungakiekie-Tāmaki Local Board covers approximately (c.) 3,647 hectares (ha) in central Auckland to the southeast of the Central Business District (CBD). It is well connected to the CBD and other parts of Auckland by both road (State Highway 1 Motorway) and rail (Southern and Eastern Lines). The local board is made up of residential suburbs such as One Tree Hill, Mt Wellington, Panmure, Glen Innes and Point England, along with the industrial areas of Penrose and Southdown, and larger commercial areas of Onehunga and Sylvia Park. The population of the local board is approximately 83,000 residents, and approximately 71.3% of the land cover is urban development.

The northern and western parts of the local board area are predominately residential, while the southern parts of the local board area are predominately commercial and industrial areas bordering the Māngere Inlet (eastern Manukau Harbour). Amongst the built-up areas are more than 100 Local Parks (14% of local board area), with some of the largest being Cornwall Park and the volcanic cones Maungakiekie / One Tree Hill, Maungarei / Mt Wellington and Ōtāhuhu / Mt Richmond.

At present the remaining indigenous forest cover is approximately 1.8%, and most open, predominately grassed areas are found in parks. Continuous tracts of urban forest in the local board area are limited to riparian vegetation in Pt England Reserve, specimen trees in Cornwall Park, restoration planting in Mutukaroa / Hamlins Hill, and pōhutukawa forest at Mt Smart. Stands of vegetation also occur on the southern slopes of Maungarei / Mt Wellington. The pine trees that formerly covered this area have been removed and are currently being replaced with 10,000 native trees (Auckland Council 2018).

Ann's Creek at the base of Hamlin's Hill is also a key biodiversity site that has been identified as a Significant Ecological Area in the Unitary Plan (Ann's Creek Lava Flow Wetland and Shrubland; SEA\_T\_5309). This site has been described as one of the best remaining coastal fringe complexes in the Auckland City isthmus. It contains one of the very last remaining pieces of basalt lava flow vegetation that would have once occupied large parts of the isthmus.

Large portions of the local board area are now zoned for development intensification under the Unitary Plan. The new zoning, including the Mixed Housing Urban Zone and the Terrace Housing and Apartment Buildings Zone, now allows for smaller sections. Consequently, much of the urban forest is under a range of pressures from development, which could potentially lead to irreversible changes in urban forest cover (Brown et al., 2015).



Mature exotic specimen trees in Cornwall Park



Indigenous restoration planting at Ann's Creek

## 2.2 Study Background

‘Urban ngahere’ (‘urban forest’) comprises all the trees within a city – including parks, coastal cliffs, stream corridors, private gardens and streets – both native and naturalised exotic species. For the purposes of this report, ‘urban ngahere’ is defined as all of the trees and other vegetation three metres or taller in stature within the Maungakiekie-Tāmaki Local Board, and the soil and water systems that support these trees. This urban ngahere definition encompasses trees and shrubs in streets, parks, private gardens, stream banks, coastal cliffs, rail corridors, and motorway margins and embankments. It also includes both planted and naturally established plants, of both exotic and native provenance.

The scale of the tree and shrub cover across Auckland is sufficiently extensive on both public and private land to make a meaningful contribution to the liveability and sense of place for its residents. Benefits of the urban ngahere include:

### Social

- Improve health and wellbeing
- Reduce the urban heat island effect
- Provide shade
- Enhance visual amenity

### Environmental

- Enhance biodiversity
- Improve air quality
- Carbon sequestration
- Improve water quality

### Economic

- Increase property values
- Reduce flood risk
- Reduce energy costs
- Reduce healthcare costs

### Cultural

- Support education
- Local food growing
- Sustain and enhance mauri
- Cultural heritage

The Auckland Unitary Plan offers various degrees of protection to urban ngahere and groups of trees meeting specific characteristics (e.g., pre-identified significance, vegetation by coasts or streams); however, other important urban ngahere assets have no statutory protection and can therefore be removed. The completion of a study in urban canopy cover in Maungakiekie-Tāmaki is important to provide information on baseline tree distribution that future canopy cover measurements can be compared to. This baseline data also provides information on where there are pressures on canopy cover and opportunities for tree planting. Increases in canopy cover are also intended to contribute to other Auckland Council programmes such as Te Tāruke-ā-Tāwhiri: Auckland’s Climate Plan (Auckland Council 2019c).

## 2.3 Data Collection

Urban canopy cover across Auckland was mapped in 2013 (Auckland Council 2019b), and again in 2016/18 by use of LiDAR (Light Detection and Ranging). Airborne LiDAR is an optical remote sensing technology that irradiates a target with a beam of light; usually a pulsed laser, to measure an object’s variable distances from the earth surface. Two LiDAR data sets are covered in this report, collected in the years 2013 and 2016/18. The second survey (2016/18) had to be completed over two years due to unfavourable weather conditions that limited data quality. As these two LiDAR data sets provide a solid baseline for future comparative work, investigations into alternatives to LiDAR for mapping urban ngahere are currently underway.

## 3.0 Results and Discussion

### 3.1 Urban Canopy Cover Overview

Based on the 2013 data set, urban ngahere covered 11% of the Maungakiekie-Tāmaki Local Board area, including 10% of roads, 21% of public parks, and 9% of private land. Further information on the 2013 data has been provided in a baseline report (Maungakiekie-Tāmaki Local Board Urban Ngahere (Forest) Analysis Report September 2019; Auckland Council 2019b).

Overall net canopy cover showed a 1% increase based on the 2016/18 data set (Table 1).

As an overview, the initial analysis contained in this report (in line with the knowing phase of the Auckland Urban Ngahere Strategy) shows that there are some obvious areas of urban ngahere concentration, while there are also areas that are lacking

urban ngahere. The lowest cover tends to be in the south of the local board (Penrose, Sylvia Park, and Panmure), while the north-eastern and western parts of the local board, around One Tree Hill, have the highest cover. The western suburbs also have larger trees and higher degrees of tree protection, such as notable trees.

The 2016/18 LiDAR data indicates net growth in canopy cover on road reserves and parks in the Maungakiekie-Tāmaki Local Board, given a combined net increase in canopy cover of c.24 hectares. Similarly, data indicates a net canopy cover increase of c.3 hectares on private land. Example of this increase has been observed on private land in the Sylvia Park area, which has had a net increase of more than 2 hectares in canopy cover since 2013. These increases are attributed to recent tree plantings including those carried out during development of the Sylvia Park Shopping Centre.

Urban Local Board	Public open space		Private land		Roads		Other public land		Overall coverage	
	2013	2016/2018	2013	2016/2018	2013	2016/2018	2013	2016/2018	2013	2016/2018
Kaipātiki	63	64	25	25	12	14	33	34	30	30
Upper Harbour	50	52	29	30	11	13	10	11	27	28
Hibiscus and Bays	28	29	24	23	15	14	43	42	25	24
Puketāpapa	50	50	17	16	10	12	15	15	20	20
Albert-Eden	33	34	19	18	17	20	19	18	20	20
Ōrākei	25	25	20	19	14	16	20	20	20	19
Waitematā	42	43	16	15	15	17	11	10	19	19
Whau	34	34	17	16	12	13	12	12	17	17
Devonport-Takapuna	24	27	17	17	11	13	13	14	16	16
Howick	25	26	17	17	6	8	11	12	16	16
Henderson-Massey	30	32	14	14	7	8	11	12	15	15
Papakura	16	17	15	15	8	11	8	9	13	14
Manurewa	24	26	11	12	6	9	7	7	12	13
Maungakiekie-Tāmaki	21	23	9	9	10	12	11	11	11	12
Ōtara-Papatoetoe	13	14	8	8	7	9	10	10	9	10
Māngere-Ōtāhuhu	14	14	7	7	7	9	8	8	8	8

Table 1: Urban ngahere in Auckland’s urban local board areas: data includes percentage cover (to nearest whole number) of urban ngahere for different land tenures, and the overall percentage cover of urban ngahere within each board, with a comparison between the 2013 and 2016/18 data sets.



### 3.2 Canopy Distribution across Maungakiekie-Tāmaki Local Board

The urban ngahere is not distributed evenly throughout the local board, as shown in **Figures 1 and 2**, which display variation by statistical area. Over the whole local board, gaps in urban ngahere are generally associated with three general categories, the first being large industrial areas. These are mainly found in the south of the board area on the northern fringes of the Manukau Harbour, such as the Southdown Industrial Area. At this location, as an example, the Metroport Container Terminal and surrounding properties represent over 100 ha of land almost entirely devoid of vegetation.

The second general category of urban ngahere gaps on a local scale is associated with high-density buildings and commercial areas. This is most noticeable in the commercial area of Onehunga, Mt Wellington, and the Sylvia Park shopping complex. Spaces in between buildings are characterised by footpaths and carparks, as well as roads, with little opportunities for urban ngahere growth.

Over half (52%) of the local board is covered in impervious surfaces, which presents an opportunity to plant urban ngahere as a direct remedy. Trees are a well-known solution for stormwater management, as their extensive canopies and subsurface root systems are capable of capturing and pumping substantial amounts of water, providing cooling effects (Berland et al. 2017). Establishing trees within impervious surfaces will act to intercept rainfall before it reaches the ground

and slows inflow rates. This has follow on benefits for stormwater management systems such as underground pipes and nearby waterways (Dwyer and Miller 1999). Opportunities exist for new tree planting in the road corridor which will assist in stormwater management by capturing stormwater flows via interception and infiltration. Trees and other ‘green infrastructure’ solutions, including rain gardens, permeable pavements, bioswales, and green roofs, are worth implementing at a greater scale and should be encouraged.

The final category of urban ngahere gaps on a local scale is associated with extensive grasslands typical of sports fields. In the Maungakiekie-Tāmaki Local Board this includes Waikaraka Park, Mt Smart Stadium,

Mt Wellington War Memorial Reserve, Pt England Reserve, Bill McKinlay Park, and larger school complexes such as Onehunga High School.

There has not been a significant change in urban tree coverage on a local scale, as shown in **Figure 2**. In general, statistical areas of Maungakiekie-Tāmaki have had only a minor increase or minor decrease in canopy cover. The only current concern may be that areas with already low tree coverage (Glen Innes East/West and Penrose) had a net decrease in cover between the two data sets. Upon examination this appears to be attributed to small scale residential tree removal and trimming of larger trees. These areas should be re-evaluated in future analysis.



The urban ngahere of Point England



# Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Maungakiekie-Tāmaki

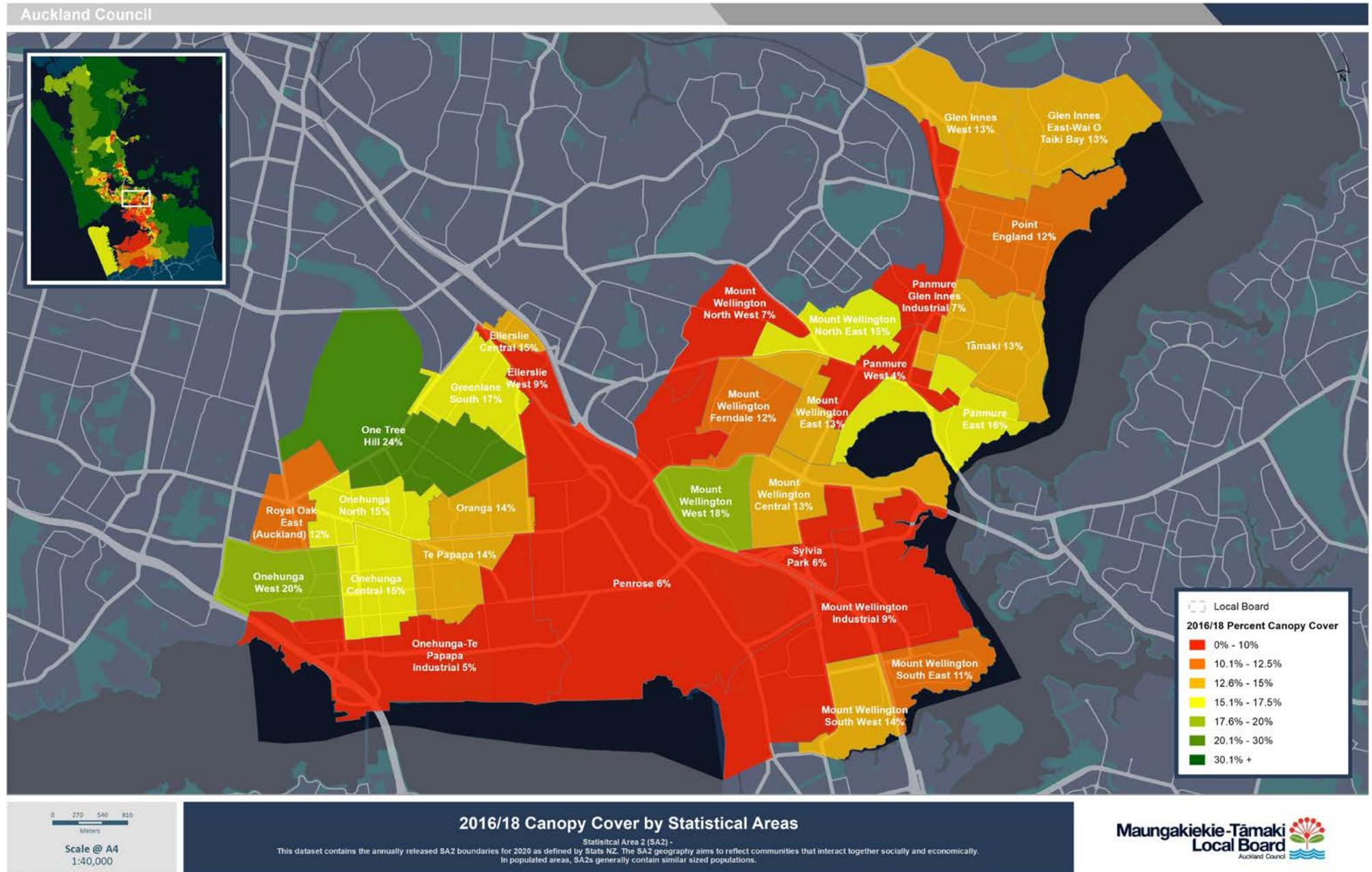


Figure 1: 2016/18 Canopy Cover by Statistical Areas

# Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Maungakiekie-Tāmaki

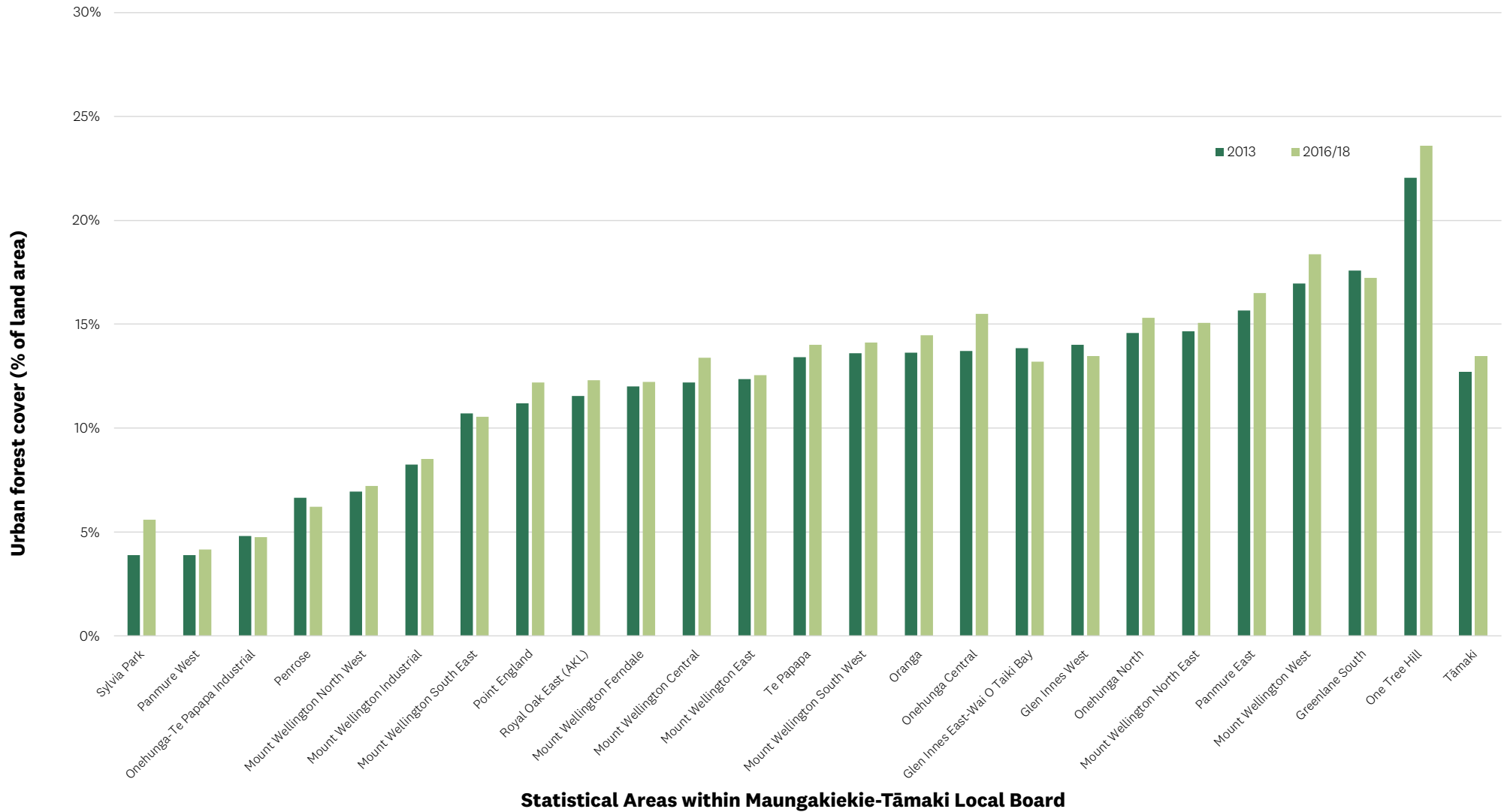


Figure 2: Spatial distribution of urban ngahere canopy within the statistical areas of Maungakiekie-Tāmaki Local Board

### 3.3 Urban Forest Canopy Height

LiDAR data includes a height component, and this information was used to split the recorded canopy cover into different height categories: 3-5 metres; 5-10 metres; 10-15 metres; 15-20 metres; 20-30 metres; and taller than 30 metres. This data is representative of canopy cover height, rather than tree height, as each individual tree may be recorded in several categories.

The height class distribution of the urban ngahere canopy within Maungakiekie-Tāmaki Local Board is displayed in **Figure 3**. In 2013, 27% of the canopy cover was between 3-5 metres tall, 44% 5-10 metres tall, and the remaining 29% was canopy taller than 10 metres. This distribution remained similar in the 2016/18 data sets, although the percentage of canopy cover over between 3-5 metres tall increased to 33% of the forest canopy. This data shows only low presence of tall canopy cover within the local board area, with all cover taller than 15 metres (including height categories 15-20 metres, 20-30 metres, and 30 metres plus) representing less than 10% of the total urban ngahere canopy assessed.

Research has shown that many of the benefits attributed to urban ngahere are disproportionately provided by larger trees (Davies et al. 2011, Moser et al. 2015). Large trees typically create more shade per tree due to a larger and wider canopy spread (Moser et al. 2015); intercept larger amounts of particulate pollutants and rainfall due to significantly larger leaf areas; contain more carbon and have higher carbon sequestration rates (Beets et al. 2012, Schwendenmann and Mitchell 2014, Dahlhausen et al. 2016). Additionally, trees are often less susceptible to careless or malicious vandalism by the general public once established; can be pruned to provide higher canopy clearance over roadways; carparks and pedestrian footpaths; typically contribute more to calming and slowing traffic on local streets than small trees; and absorb more gaseous pollutants. It is therefore an immediate priority to retain existing large trees across the local board area to ensure the positive benefits of these are not lost, as also emphasised in the Urban Ngahere Strategy (Auckland Council 2019a).

Conversely, the relatively high proportion of shorter canopy cover across the local board (33% 3-5m tall and 43% 5-10m tall) in the 2016/18 data set, indicates a relatively recent surge of tree planting, assuming the smaller stature canopy corresponds to younger trees, rather than shrubs which are limited at their mature height.

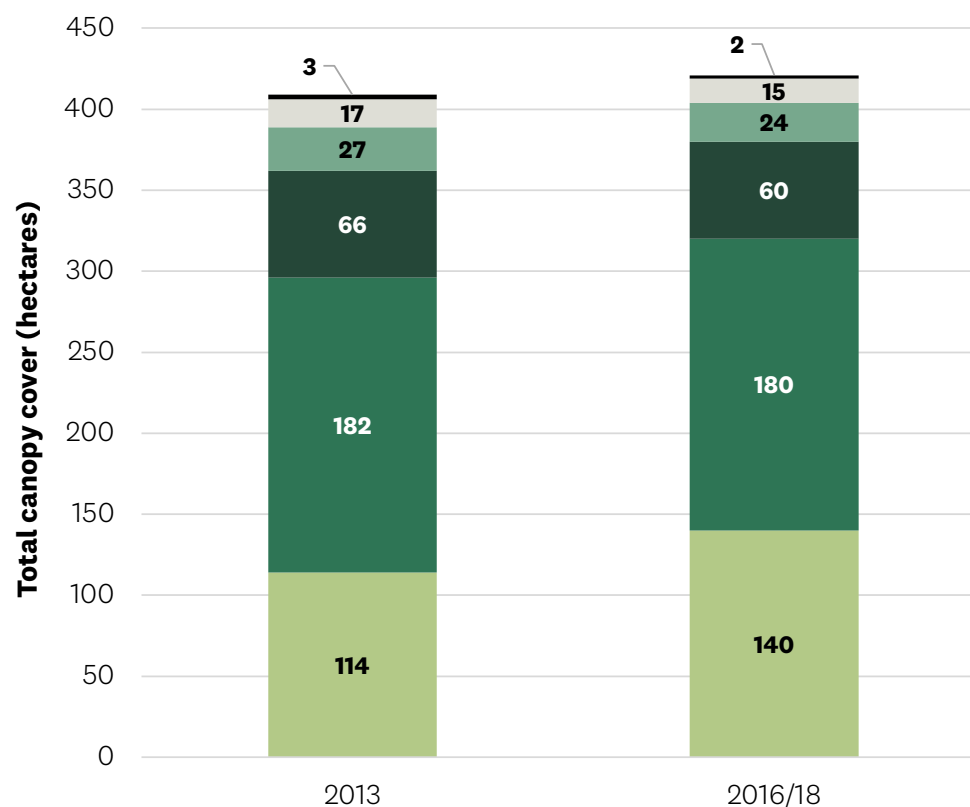


Figure 3: Height class distribution of urban ngahere canopy across all land tenures within Maungakiekie-Tāmaki Local Board



### 3.4 Urban Ngahere Tenure

The tenure of urban ngahere described in this report relates to the zoning and ownership of different land parcels within the local board. Publicly owned land is described as either ‘public parks’ or ‘other public land’ (e.g. schools, Council-owned property), trees in the road corridor/road reserves are described as ‘street trees’, and privately owned land (residential or commercial) is described as ‘private land’.

The tenure distribution of urban ngahere canopy within the Maungakiekie-Tāmaki Local Board is displayed in **Figure 4**. Nearly half (49%) of the urban ngahere in Maungakiekie-Tāmaki is located on private property, which is reflective of the board area being colonised relatively early in Auckland’s history. Public parks and other publicly owned land (e.g., schools) contain a similar proportion of urban ngahere, being 29% and 22% of the total urban ngahere cover, respectively.

Public parks have the highest proportion of urban ngahere relative to area out of all the land tenures, as shown in **Figure 5**, followed by road reserves and other public land. There has also been an increase in urban ngahere canopy in public parks, as well as road reserves/road corridors, between the two survey data sets. The percentage canopy cover of other public land and private land has stayed the same.

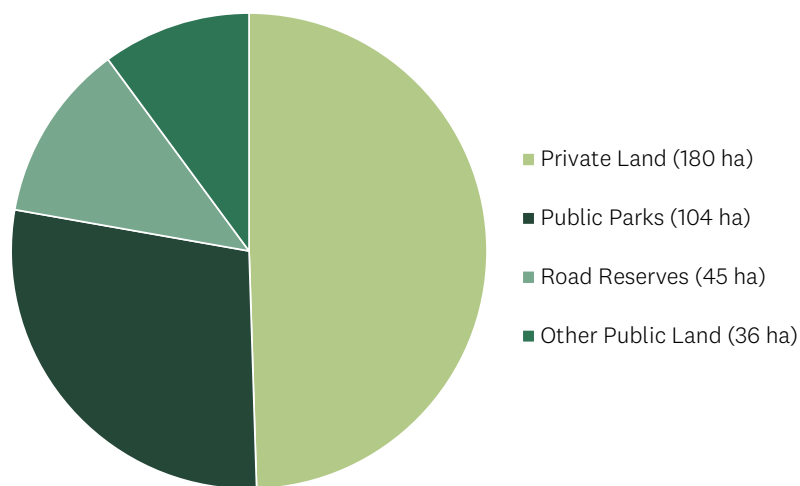


Figure 4: Tenure of urban ngahere canopy within Maungakiekie-Tāmaki Local Board (Auckland Council 2019b)

The urban ngahere cover on private land within the local board area is much lower than would be expected, with only 9% coverage. This is attributed to the high proportion of privately owned commercial and industrial sites, rather than an absence of urban ngahere on residential properties. The large tracts of commercial and industrial land with large buildings, warehouses, and concreted yards, provide few opportunities for urban ngahere development aside from in road reserves. It is a priority for the local board to take available opportunities to increase private land coverage in these locations, particularly around Penrose. There are smaller parts of the local board, for example Glen Innes, where cover on residential properties could also be improved.

Public parks are also good place to focus additional urban ngahere planting as they comprise approximately 14% of the local board land area and are widely distributed. In addition, public parks offer the best opportunities for long-term sustainable management of the urban ngahere due to the lower chance of conflict with future housing intensification.

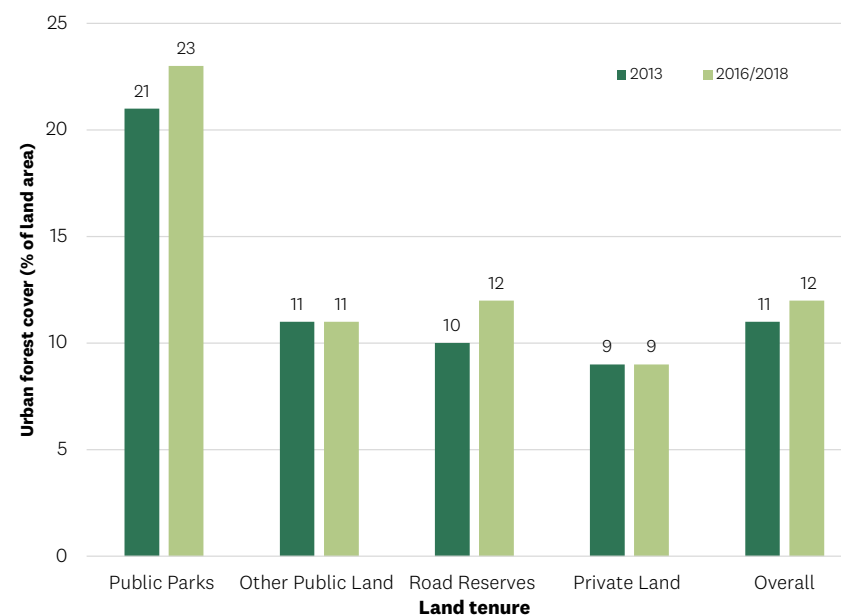


Figure 5: Change in urban ngahere cover of different land tenures in Maungakiekie-Tāmaki Local Board between 2013 and 2016/18

## 3.5 Urban Ngahere in Relation to Growth Pressures

The Significant Ecological Area overlay (SEA; **Figure 6**) prioritises the areas of urban ngahere in Maungakiekie-Tāmaki with the highest ecological value, providing a starting point for protection. With future development and urban intensification, however, SEA and other continuous areas of urban ngahere are at risk. Canopy cover in relation to the Auckland Future Urban Land Supply Strategy (Auckland Council 2017) forecasting areas of growth is shown in **Figure 7**.

A large degree of new growth in the Maungakiekie-Tāmaki Local Board will occur in association with the Tāmaki Regeneration Programme, primarily in the suburbs of Glen Innes, Point England, and Panmure. It is aimed to build over 5,100 new homes over the next 20 years, and create training, employment and business pathways for the community to prosper (see [www.tamakiregeneration.co.nz](http://www.tamakiregeneration.co.nz)). The new homes are largely to be built in the location of existing residential development, at a higher density. This demonstrates a scenario whereby urban ngahere loss is occurring for development, and presents a need to ensure new developments incorporate new urban ngahere plantings to match and extend the urban ngahere that has been lost.

In the north-eastern parts of the Maungakiekie-Tāmaki Local Board, and around Onehunga, much of the land is zoned 'Residential – Terrace Housing and Apartment Buildings', which is the highest density zone for urban residential development. Converting existing residential properties into this new land use has the potential to see a greater loss of urban ngahere, particularly in regard to trees that can be removed as a permitted activity (i.e., no protection status), as tree removal may increase the development potential of the site. The retaining of all protected vegetation (including Notable Trees) is important.

Protecting existing and adding to the numbers of trees in the road corridor is an important and ongoing measure to retain and extend urban ngahere cover, as the tree cover in the road corridor is currently low. The importance of trees in the street environment is going to increase, and will, in time, incorporate the only accessible trees for some residents.

To this end, the Maungakiekie-Tāmaki Local Board is encouraged to work with Auckland Council to readdress the current rules for tree and vegetation protection, especially in relation to highlighting the importance of large trees and the multiple benefits they offer to the local community.



Coastal Native plantings along The Tāmaki Estuary



# Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Maungakiekie-Tāmaki

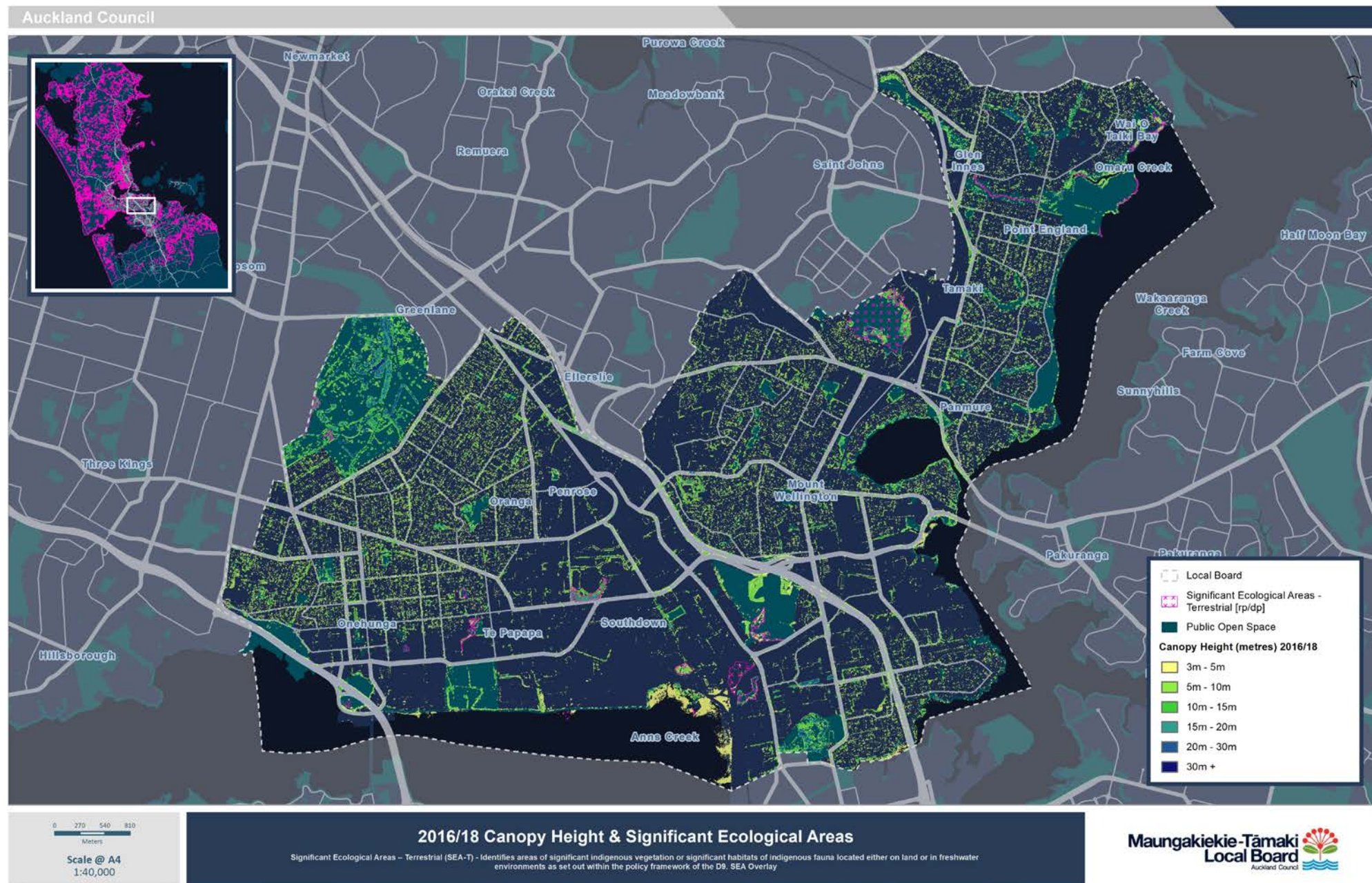


Figure 6: 2016/18 Canopy Height & Significant Ecological Areas



# Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Maungakiekie-Tāmaki

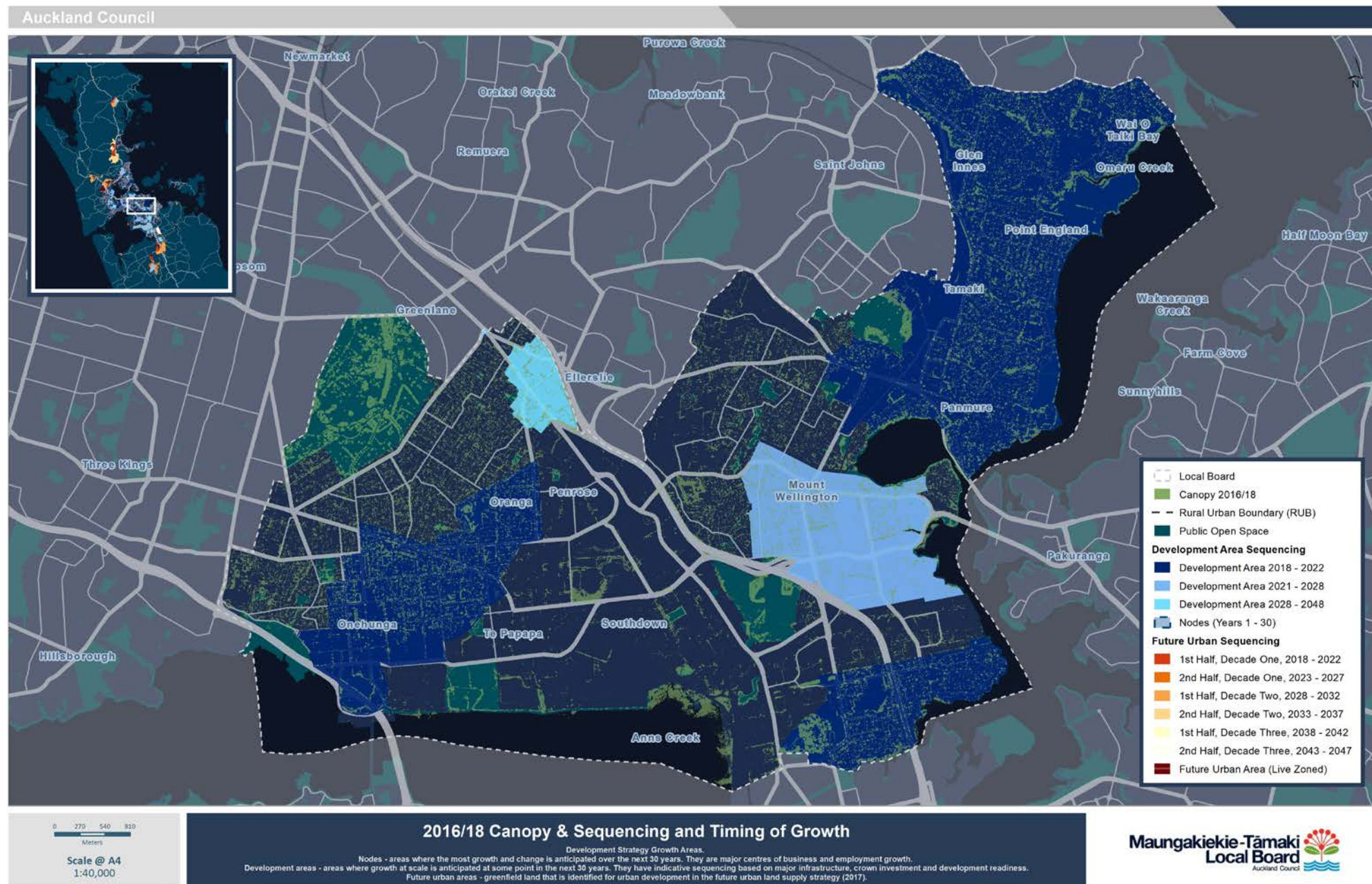


Figure 7: 2016/18 Canopy & Sequencing and Timing of Growth



## 3.6 Recommendations

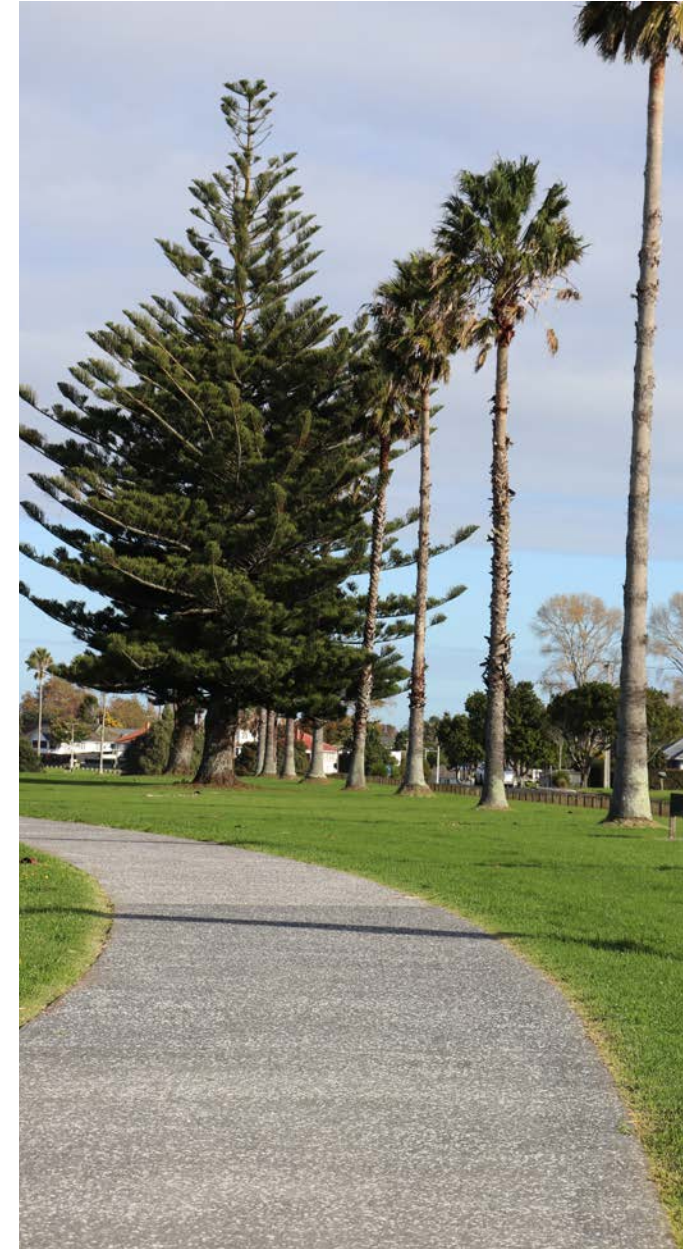
The assessment of urban tree cover in the Maungakiekie-Tāmaki Local Board presented in this update report aims to assist in the knowing phase of the Auckland Urban Forest Strategy. The analysis of existing tree cover distribution, structure, tenure, and protection, provides the local board with a basis for determining where to focus efforts in improving urban ngahere cover during the growing phase, to be initiated in the near future.

Recommendations for future urban ngahere management to the Maungakiekie-Tāmaki Local Board include:

- Work with all stakeholders to implement the local board urban ngahere action plan 2021
- initiate tree planting where possible in unused corners or edges of sports parks, including Point England Reserve
- identify parks containing playgrounds with low tree shading (e.g., Fong Reserve, West Tāmaki Reserve, Hobson Reserve) and obtain funding for large grade specimen trees to plant

- investigate potential for retrofitting and including green infrastructure in new commercial and residential developments, and how this could become a requirement for developers
- undertake connectivity analysis of native plantings (e.g., along Omaru Creek) and determine target locations for increasing urban ngahere cover in parks and road reserves to create ecological corridors to other concentrated vegetation
- use connectivity analysis to inform future updates to the local board urban ngahere action plan
- look to citizen science to set up long term study to monitor biodiversity improvements resulting from the growing phase of the urban ngahere strategy (e.g., regular bird count stations).

The metrics of the canopy analysis will be used to help inform and prioritise the efforts of the Maungakiekie-Tāmaki Urban Ngahere Action Plan. The action plan highlights the areas to plant new trees and sets out the process to fund, implement, and find ways to protect and nurture existing ngahere on public and private land.



The Tāmaki Path, Riverside Reserve, Point England

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- Content prepared by Carolina Stavert and Jessica Reaburn (Wildland Consultants Ltd).
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- Graphics and formatting completed by Q Brand Agency.

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## 5.0 References

Auckland Council (2017). Auckland Future Urban Land Supply Strategy. <https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/housing-plans/Documents/future-urban-land-supply-strategy.pdf>

Auckland Council (2019a). Auckland’s Urban Ngahere (Forest) Strategy. Published by Auckland Council’s Auckland Plan, Strategy and Research Department, March 2019. <https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/Documents/urban-ngahere-forest-strategy.pdf>

Auckland Council (2019b), unpublished. Maungakiekie-Tāmaki Local Board Urban Ngahere (Forest) Analysis Report September 2019. Prepared by Howell Davies and Wildland Consultants Ltd for the Maungakiekie-Tāmaki Local Board Locally Driven Initiatives – Ngahere Work Programme: Year 1 Knowing Phase.

Auckland Council (2019b). Te Tāruke-ā-Tāwhiri: Auckland’s Climate Plan. Developed from Auckland’s Climate Action Framework consultation summary published by Auckland Plan, Strategy and Research Department, June 2019. <https://www.aucklandcouncil.govt.nz/environment/Documents/te-taruke-a-tawhiri-auckland-climate-plan.pdf>

Beets, P. N., M. O. Kimberley, G. R. Oliver, S. H. Pearce, J. D. Graham and A. Brandon (2012). *Allometric Equations for Estimating Carbon Stocks in Natural Forest in New Zealand*. Forests 3: 818-839.

Berland, A., Shiflett, S.A., Shuster, W.D., Garmestani, A.S., Goddard, H.C., Herrmann, D.L. and Hopton, M.E. (2017). *The role of trees in urban stormwater management*. Landscape and Urban Planning 162: 167-177.

Brown, M. A., Simcock, R. and S. Greenhalgh (2015). Protecting the Urban Forest. Landcare Research Manaaki Whenua Policy Brief No. 13 (Issn: 2357-1713).

Dahlhausen, J., P. Biber, T. Rötzer, E. Uhl and H. Pretzsch (2016). *Tree Species and Their Space Requirements in Six Urban Environments Worldwide*. Forests 7: 111-130.

Davies, Z. G., J. L. Edmondson, A. Heinemeyer, J. R. Leake and K. J. Gaston (2011). *Mapping an urban ecosystem service: quantifying above-ground carbon storage at a citywide scale*. Journal of Applied Ecology 48(5): 1125-1134.

Dwyer, M.C. and Miller, R.W. 1999. *Using GIS to assess urban tree canopy benefits and surrounding greenscape distributions*. Journal of Arboriculture 25(2): 102-107.

Moser, A., T. Rötzer, S. Pauleit and H. Pretzsch (2015). *Structure and ecosystem services of small-leaved lime (Tilia cordata Mill.) and black locust (Robinia pseudoacacia L.) in urban environments*. Urban Forestry and Urban Greening 14: 1110-1121.

Schwendenmann, L. and N. D. Mitchell (2014). *Carbon accumulation by native trees and soils in an urban park, Auckland*. New Zealand Journal of Ecology 38 (2): 213-220.



