Devonport-Takapuna Local Board Workshop Programme

Date of Workshop: Tuesday 11 June 2024
Time: 1.00pm – 3.00pm
Venue: Devonport-Takapuna Local Board Office, Ground Floor, 1-7 The Strand, Takapuna and MS Teams
Apologies:

Time	Workshop Item	Presenter	Governance role	Proposed Outcome(s)
1.00 – 2.00	**1. Parks & Community Facilities** - Urban Ngahere **Attachments:** **1.1** Devonport-Takapuna Urban Ngahere implementation Memo **1.2** Draft Canopy Analysis Report Devonport-Takapuna April 2024	**Howell Davies** Principal Specialist Urban Ngahere	Keeping informed	Receive update on progress
2.00 – 3.00	**2. Auckland Emergency Management** - Emergency Response and Readiness Plan **Attachments:** **2.1** DTLB ERRP Memo 110624 **2.2** DTLB ERRP presentation 110624 **2.3** DTLB ERRP **2.4** AEM group plan 2024-2029 **2.5** Draft Launch Strategy June 2024	**Jessica Donaldson** Senior Community Planning and Readiness Advisor	Keeping informed / Local initiative	Receive update on progress / provide direction on preferred approach

Next workshop:

Tuesday 2 July 2024

- Connected Communities monthly update
- Full Facilities Contract Performance update
- EV Charging in Devonport
- Bayswater Ferry Terminal update

- Devonport Peninsula Trust / Restoring Takarunga Hauraki lease
- Knightsbridge Reserve Playground

Role of Workshop:

(a) Workshops do not have decision-making authority.

(b) Workshops are used to canvass issues, prepare local board members for upcoming decisions and to enable discussion between elected members and staff.

(c) Members are respectfully reminded of their Code of Conduct obligations with respect to conflicts of interest and confidentiality.

(d) Workshops for groups of local boards can be held giving local boards the chance to work together on common interests or topics.

Devonport-Takapuna Local Board Workshop Record

Date of Workshop: Tuesday 11 June 2024
Time: 9.30am – 2.50pm
Venue: Devonport-Takapuna Local Board Office, Ground Floor, 1 The Strand, Takapuna and MS Teams

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Attendees

Chairperson:	Toni van Tonder
Deputy Chairperson:	Terence Harpur
Members:	Peter Allen *(online)*
	Gavin Busch
	Melissa Powell
	George Wood, CNZM
Staff:	Trina Thompson – Local Area Manager
	Maureen Buchanan – Senior Local Board Advisor
	Rhiannon Guinness – Local Board Advisor
	Henare King – Democracy Advisor

Apologies

None

Workshop item	Presenters	Governance role	Summary of discussion and Action points
1. Parks & Community Facilities - Urban Ngahere	**Howell Davies** Principal Specialist Urban Ngahere	Keeping informed	The local board was provided with an update on the draft canopy analysis report. The local board raised the following points and questions in response to the presentation: • Questioned how staff suggest the board navigate playground renewals around tree roots, if we want to encourage canopy coverage. Staff suggested bespoke and innovative design rather than off-the-shelf playgrounds. • Clarified that Plan Change 78 requires development sites to have a minimum number of trees and soil depth. • Questioned how many trees have been lost during recent storms and if it contributed to tree decline in the local board area. Staff noted that tree stock is fairly resilient, but some significantly sized trees have been lost – data will be sought for trees lost in the past 5 years. • Requested data from the local board area on how many tree removal requests are made. • Clarified how AI modelling works and why it takes as long as it does. • Suggestion to provide vouchers for tree planting on berms using local board funds. Next Steps: • Canopy Analysis report to be endorsed at a business meeting.

2. Auckland Emergency Management - Emergency Response and Readiness Plan	**Jessica Donaldson** Senior Community Planning and Readiness Advisor **Zoe Marr** Community Planning and Readiness Manager	Keeping informed / local initiative	The local board was provided with an update on the Devonport-Takapuna Emergency Response and Readiness Plan • Member T Harpur left the meeting at 2.30pm. The local board raised the following points and questions in response to the presentation: • Concern that the Takapuna/Hauraki Emergency Response Group is headed by someone who does not live in the area. There have been as the group seemed to be concerned regarding what it might be liable for. issues recently making contact. • Appreciative of the work that has gone into this, noting that there is more confidence in the processes for when another storm event occurs. • Concern that plans are to be tailored by individual community groups, instead of being a consistent and all-encompassing plan. Members suggest that the plan remain consistent, groups can make minor changes to reflect local circumstances, but the main focus areas of the plan should not be amended. • Suggested to connect more with the Milford community, noting the recent buyout meeting there was well-attended. • Clarified that transitioning to Auckland Emergency Management branding is ongoing, noting that the branding of Civil Defence is still regionally recognised. • Questioned what features could be included in the renovation of the Takapuna Library that would be beneficial in an emergency event. Staff noted spaces for privacy during an emergency were often valuable. Showers and cooking facilities only valuable if we have power. Suggested and external power point and tap. • Clarified the Devonport Community House was excluded from the Devonport Emergency plan because it is in a flood zone, but it can still be used in other emergency events. Concern raised that the local community house is not recognised as an emergency hub. Members asked that this be explored as it could cause confusion if we are promoting community house as somewhere people can gather for info and advice. Next Steps: • Final workshop with the Local Board • Plan adopted at a business meeting.

The workshop concluded at 2.50pm.

Memorandum

11 June 2024

To: Devonport-Takapuna Local Board

Subject: Devonport-Takapuna draft Urban Ngahere Canopy Analysis Report 2024

From: Howell Davies, Principal Specialist - Urban Ngahere (Forest), Specialist Operations, Parks and Community Facilities

Contact information: howell.davies@aucklandcouncil.govt.nz

Purpose

1. To present and receive feedback from the Devonport-Takapuna Local Board on the draft Urban Canopy Cover Analysis Report 2024.

Summary

2. This memo provides advice to the Devonport-Takapuna Local Board to better understand the status and value of the urban ngahere in the local area.
3. The attached draft Urban Ngahere Canopy Cover Analysis Report 2024 shows the canopy cover changes in the local board area using two types of analysis. Analysis between 2013 and 2016-2018 used Light Detection and Ranging (LiDAR) and between 2017 to 2022 used Machine Learning Artificial Intelligence (AI) to analyse aerial imagery.
4. The two methods of analysis provide data sets that can be contextualised into a view of vegetation and tree canopy cover changes over a period of nine years across the Auckland region.
5. Analysis of the canopy cover showed net overall canopy cover between 2013 and 2016-2018 remained at 16 per cent in the Devonport-Takapuna local board area.
6. There was a one per cent net loss of canopy cover on private land. This reduction was offset by an increase in canopy cover on public land and in the road transport corridor.
7. Following any local board feedback, changes will be made to the report which will be reported to a business meeting for formal approval. The findings and recommendations of the canopy analysis report will inform the development of the Devonport-Takapuna 10-year Ngahere Action Plan. This plan will guide the next ‘Growing’ phase - future tree planting to increase canopy cover on public land.

Context

8. Auckland’s Urban Ngahere (Forest) Strategy (2019) - Te Rautaki Ngahere ā-Tāone o Tāmaki Makaurau consolidates and builds upon existing directives that support our urban ngahere and sets out a clear framework to protect and grow Auckland’s urban ngahere for a flourishing future.
9. There are three strategy outcomes:
   a) Knowing
   b) Growing
   c) Protecting.

10. The implementation framework identifies eighteen high level actions, one of which relates to local boards:

Section 6.3 Whakatinanatanga ā-wāhi motuhake – Area specific implementation framework.

> The strategy must take an area specific approach to implementation. This will require engaging with each local board, partners, and stakeholders to discuss needs and drivers for growing and protecting Auckland's urban ngahere. This will ensure the strategy's high-level actions are defined and implemented in a way that matches the needs of each local area.

11. Devonport-Takapuna is the seventeenth local board to adopt a local approach to implementing a response to the strategy to ensure that the average canopy cover is increased to 30 per cent across Auckland's urban area, with no local board area having less than 15 per cent canopy cover.

12. This board is the first to receive a canopy analysis report informed by the new artificial intelligence method for reviewing data, which is a more cost effective and efficient method of review.

13. This memo provides advice to Devonport-Takapuna Local Board to better understand the status and value of the urban ngahere in the local area, as part of the 'Knowing' strategic outcome.

14. The local board allocated LDI Opex $15,000 in the 2023/2024 financial year and $15,000 approved in principle for the 2024/2025 financial year to complete the 'Knowing' phase in two parts. The second part of the 'Knowing' phase is the Devonport-Takapuna Urban Ngahere Action Plan, which will be delivered next financial year.

Discussion

15. The attached draft Urban Canopy Cover Analysis Report 2024 outlining changes in tree canopy coverage between 2013-2018 and 2017-2022 has been prepared for the board to review the aerial imagery data.

16. The findings from the Light detection and ranging (LiDAR) analysis work is outlined in sections 3.1 and 3.2 of the attached draft Urban Canopy Cover Analysis Report 2024. The findings were based on two sets of LiDAR data produced from surveying in 2013 and 2016-2018.

17. High-level comparison of the two LiDAR data sets shows a very minor net increase in the tree canopy coverage across land in public ownership. Overall, the net tree canopy cover remained at 16 per cent in 2018. The net increase in overall cover was 0.7 per cent, and overall net changes in the extent of canopy cover amounted to a per cent change between 2017-2022.

Table 1: Comparison of urban ngahere canopy cover from 2013 to 2022

Survey date and analysis type	Public land	Private Land	Total net canopy cover	% net change since previous survey
2013 LiDAR	24%	17%	16%	
2016-2018 LiDAR	27%	17%	16%	0.7% gain
2017 AI	in progress	in progress	22%	
2022 AI	in progress	in progress	In progress	~1.0% loss*

* The figures shown are indicative only for the aerial analysis

18. Between 2017 and 2022, the analysis using the Machine Learning Artificial Intelligence (AI) technique indicates a net reduction in the overall extent of tree canopy cover in the Devonport-Takapuna local board area.

19. Early results indicate a continued trend in tree canopy loss on privately owned land. Some observations show that larger losses can be attributed to urban intensification, or land use changes. An example of the change in land use has been included in the report to illustrate the trend that appears to be developing with implementation of the Auckland Unitary Plan.

20. In the attached report, page 11, Figure 1 identifies the canopy cover across the local board area with Takapuna South the highest at 23 per cent, and Westlake the lowest at 13 per cent. Areas with canopy cover less than 15 per cent will be areas to target when preparing the local urban ngahere action plan.

Next steps

21. Staff will incorporate the local board's feedback to update the draft Devonport-Takapuna Urban Ngahere Canopy Analysis Report 2024 and provide a report at a business meeting for formal approval.

22. After approval, the canopy analysis findings will guide the second part of the 'Knowing' phase – the Devonport-Takapuna 10-year Ngahere Action Plan. This will outline a plan for canopy cover increase across the local board area on public land. The plan will help to coordinate efforts to plant more of the right trees in the right place to provide long term benefits to local communities across the Devonport-Takapuna Local Board area.

23. Funding for planting new trees will be either: part of the local board work programme activities, or as part of the planning and delivery of new projects.

Attachments

A. Draft Devonport-Takapuna draft Urban Ngahere Canopy Analysis Report 2024

B. Auckland's Urban Ngahere (Forest) Strategy (2019) - Te Rautaki Ngahere ā-Tāone o Tāmaki Makaurau

Devonport-Takapuna Local Board Canopy Analysis Report 2024

HOWELL DAVIES
GRANT LAWRENCE
TIM GUO
HAOTIAN ZHAO

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

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4.1 Recommendations 39
The recommended next steps are guided by the initial draft results obtained from the analysis work outlined in section 3.0. The work is based on analysis of data derived from the Aerial imagery analysis undertaken on imagery from 2017 and 2022 and the results of this work have been over laid with the LiDAR data analysis work from 2013-2018. 39
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DRAFT

1.0 Preface

Tāmaki-Makaurau / Auckland, New Zealand's largest city, has an estimated population of 1,673,220. It is located in the North Island and covers an area of 4,941.13 square kilometres. The region is bounded by three large harbours: the Manukau and Kaipara Harbours on the West Coast and the Waitemata Harbour on the East Coast. The landscape of the region has evolved and changed over many centuries of human occupation. Early Māori settlers would have cleared areas of forest to establish gardens and in other areas planted trees such as karaka, pūriri and tōtara to indicate a special place or to mark a celebration. European settlers arrived in the early 1840's and brought with them a range of plants that were from their homeland.

Over the last 180 years the landscape of the region has experienced remarkable change. What was a landscape of native vegetation has given way to a much wider range of species. Land development and housing has seen exotic trees from a range of continents and climate types being introduced and planted in private gardens, parks, and along streets across Auckland. Several city streets are lined with London plane trees that were planted over one hundred years ago. This species is from the Northern Hemisphere and is a familiar sight in historic European landscapes. The coastal temperate climate of Auckland can support a vast range of species of both native and exotic trees, shrubs and plants.

Tree species from warmer areas in Asia, Australia and the South Pacific regions are commonly found in Auckland's landscape. The region has a complex blend of native and exotic species of trees and shrubs, these natural and planted areas collectively make up the urban ngahere (forest).

Auckland Council owns and manages over 4000 parks across the region and is responsible for the management of the landscape on public land. Regionally there are 36 different types of native ecosystem[1i] . In urban areas there is a wide range of native and exotic vegetation cover types that make up the urban ngahere (forest).

In the Devonport-Takapuna Local Board area, there are five main forest ecosystem types. One of these ecosystem types is CL1 - Pohutukawa treeland/flaxland/rockland. Under the Regional IUCN[2] threat status classification this type of forest is considered regionally vulnerable. There are only small pockets left of the original native vegetation cover, and the council has identified sixteen different types of ecosystem including forests, cliff, wetlands, saline, exotic forest, exotic scrub, exotic wetland, and planted vegetation.

[1] Refer Indigenous terrestrial and wetland ecosystems of Auckland.

[2] IUCN – International Union for the conservation of nature

2.0 Introduction

Auckland Council's Urban Ngahere (Forest) Strategy was approved in 2019. The strategy outlines 18 key high-level actions under the objectives of Knowing, Growing and Protecting. The Ngahere programme for local boards has been developed to help provide specialist advice, guidance, and assistance to help implement the strategy at a local level.

The councils regional ngahere programme aims to provide detailed information on the extent of the tree canopy coverage in each local board area with a Canopy Analysis Report. The report findings will be used to develop and inform development of a long term Ngahere Action Plan that will help to direct planting efforts in those areas of most need. The Action Plan is designed to provide direction for Council, the Local Board and its communities on where to action new tree planting projects to help grow the tree canopy coverage in areas with the lowest canopy cover.

2.1 Devonport-Takapuna Local Board

The Devonport-Takapuna Local Board have provided funding to enable the development of an Urban Ngahere (Forest) Analysis Report ("Report") which aims to describe and assess the extent of tree canopy coverage within the boundaries of the local board area.

The Devonport-Takapuna Local Board area is located on the North Shore of the inner Waitemata Harbour and has a population of approximately 59,975 people. Around 70% of the population identify as European, 26% identify as Asian, 5.5% identify as Māori, 2.5% Pacific Islander, 2.5% Middle Eastern/Latin American/African and 1.2% identified as belonging to a group classified as Other Ethnicity.[3]

The geography of the area is dominated by three volcanic cones (maunga): Takapuna, Takarunga and Takararo. Lake Pupuke is an extinct volcanic crater approximately 150,000 years old and is one of the largest naturally formed freshwater lakes on the North Shore. The area has several well-known, popular sandy beaches at Takapuna, Cheltenham and Narrow Neck.

The Devonport – Takapuna area has a culturally rich heritage as the three Maunga are believed to have been developed by Māori from around 1350AD. The maunga were fortified pah sites for local Māori tribes and the fertile slopes were extensively used for market gardening to supply food. European settlement began in the 1840's with farming and ship building being the mainstays of the local economy. The deep-water anchorage around North Head was suitable for naval vessels and in 1888 the largest drydock in the Southern Hemisphere, Calliope Dock, was opened. The Royal New Zealand Navy still retains a significant presence in Devonport which is home to the Devonport Naval Base.

The vegetation cover across the area has experienced significant change and only a few small pockets are left of the original native tree cover. The urbanisation of the area has seen significant land use changes take place. Before the construction of the Harbour Bridge the area was only accessible from the central city by car and pedestrian ferries.

[3] *https://www.stats.govt.nz/tools/2018-census-place-summaries/devonport-takapuna-local-board-area*

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

Following the opening of the Harbour Bridge in 1959 the North Shore, including Devonport and Takapuna, experienced significant residential development.

The older areas of settlement around Stanley Point, Devonport and Cheltenham feature a number of heritage architectural styles, and the section sizes are generally large with well-established trees and gardens. In contrast the more recent development that has occurred in the last 30 years has included multi-storey apartment buildings, terraced housing, and smaller section sizes. The area will see further development on private land, with increased housing density, and brownfield redevelopment.

Takapuna is identified in the Auckland Plan as an area that is capable of further development and has capacity for increased housing density. The Auckland Plan outlines that Council is investing in open space upgrades in the area, has identified the area as part of the urban regeneration programme and is concentrating on redevelopment of a few key sites. The Auckland Plan predicts population growth of around 11,635 and an increase of 5,390 new households.

2.1.1 Study Background

Section 35(2) of the Resource Management Act 1991 (RMA) requires councils to monitor the efficiency and effectiveness of any policy statements and plans prepared under the RMA. Baseline information on the extent of the urban tree coverage was established by Council in the technical report 'The Urban Forest of Waitemata Local Board in 2013' Technical report 2017/006.

The Urban Ngahere (Forest) Strategy 2019 outlines a number of key high-level actions to help manage the urban forest across the region to achieve an increase in tree canopy coverage from the current 18% to 30% and aligning to the Auckland Plan time frame of 2050. The Auckland region will experience growth and the population is expected to be around 2.4 million by 2050. Tree canopy loss is anticipated with future urban development and densification, however new green field developments will see planting on public and private land; so there will be a constant churn of change with tree canopy cover.

The Strategy outlines high level actions under the main priority areas of knowing, growing, and protecting. The knowing objective has six high level actions, to support the outcomes of:

- Better understanding of the status and trends on private and public land over time
- Better understanding of the diverse values and benefits of Auckland's urban forest
- Better understanding of existing and future risks and pressures.

To enable Council to have a better understanding of the changes that are taking place in the regional tree canopy coverage a programme of work has been set up with Long Term Plan funding to track the changes that take place with the tree canopy cover on public and private land up to 2031. The extent of tree canopy coverage for the region was first reported in 2018 using LiDAR data captured in 2013.

A further capture of LiDAR took place in 2016-2018 and a technical report was produced in 2021 – 'Auckland's Urban Forest Canopy Cover: State and Change (2013-2016/2018). Revised April 2021'. The report has provided details on the changes to the extent of urban tree canopy coverage for those Local Board areas that are predominantly urban. The report on the comparative changes in tree canopy cover has been used to help direct efforts on implementing ways to grow and protect the tree canopy cover.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

The purpose of this report is to provide a detailed analysis of a variety of data sets and statistics on the extent of urban tree cover on public and private land across the Devonport Takapuna Local board area. The analysis includes consideration of the potential risks of low tree cover, the potential benefits of increasing tree canopy cover and outlines where opportunities exist to enhance existing tree canopy cover on public land.

The report aims to provide an accurate baseline of tree distribution across Devonport-Takapuna so that any future measurements can be compared to. The baseline data results provide information that will help to inform development of a long-term plan to increase the tree canopy cover in public parks and along streets. Increasing tree canopy cover provides a range of benefits to residents.

2.1.2 Data Collection

The first estimates of tree canopy cover change presented were derived from aerial LiDAR (Light Detection and Ranging) captured in 2013 and again in 2016-18 (region captured over multiple flying seasons). Aerial 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's surface. The data is used to build a three-dimensional image of the area surveyed.

The definition of 'urban forest' for coverage estimates derived from LiDAR in this report is all trees and other vegetation that are three metres or taller in stature. Firstly, the ecosystem services provided by trees generally increases with size and secondly, this is the same height threshold applied in the 2013 LiDAR tree canopy cover mapping for Auckland, so comparison between the two time periods can be made.

While the LiDAR methodology and the analysis of the LiDAR data conducted by Auckland Council provides a solid baseline for future comparative work, investigations into alternatives to LiDAR for mapping canopy cover are currently underway.

In section 3.8 Case Study, we present one of the new methods Auckland Council is evaluating that uses aerial imagery to quantify the extent of canopy cover. This type of method will be able to take advantage of more frequently captured aerial imagery and although canopy estimates are not directly comparable with LiDAR, this provides continuity and complimentary estimates of canopy cover through time. Both aerial LiDAR and aerial imagery are collected by Auckland Council for a variety of applications, of which urban canopy cover monitoring is just one.

Updated metrics on regional canopy cover changes can therefore be generated pending the availability of regional aerial survey data (LiDAR or Imagery) over time.

The investigative work is being funded by the Long-Term Plan and is currently exploring the use of Artificial Intelligence (AI) to assess vegetation canopy coverage with machine learning techniques.

The metrics of this work are showing very encouraging results with a high level of accuracy, that is comparable to a human level of assessment of the same imagery.

The findings of the LiDAR estimates for 2013 to 2018 and the two aerial imagery estimates from 2017 to 2023 are covered in section 3.0 Results and Discussion.

The Case Study section in section 3.7 contains an outline of the type of AI techniques that are being developed and tested by council's experts to analyse regional tree canopy coverage using aerial imagery. Once the regional tree canopy coverage analysis is completed using the AI model, a report will be published and further detailed analysis can be provided to all Local Boards on the extent of changes that have taken place in the tree canopy coverage from 2017 to 2023/24.

In October 2024 Council's Ngahere Project Team aim to produce an updated report on the regional tree canopy cover changes that have taken place (derived from aerial imagery). The findings of the analysis work will help to inform Council's ongoing Environmental Monitoring Programme on the trajectory of change that is taking place with the regional tree canopy coverage. This information will be used by council to help direct future efforts to increase tree canopy cover in the right areas. Interpretating different tree canopy cover measurements.

The AI model currently being developed for canopy cover extraction has achieved a performance score greater than 90%accuracy using 2017 aerial imagery, the accuracy of the results are comparable to those achieved with LiDAR assessment from 2016.

The AI model has been trained to detect trees and vegetation, so the coverage results will include vegetation that is less than 3 metres in height. The process of using AI analysis provides a two-dimensional picture on the overall extent of coverage of vegetation including tree canopies, grass and grassland areas are specifically excluded from this assessment technique.

The LiDAR analysis work measured the extent of tree canopy coverage at 3 metres and above, so the results of the two processes of analysis are useful as quality checks for each process however the results of the two cannot be directly compared.

The analysis processes of Ai and LiDAR are complementary and help council to analyse canopy cover change over an extended period. Monitoring change provides the metrics required for the councils reporting responsibilities (Section 35 RMA) and to inform decisions on where efforts need to be focused to preserve and grow tree cover.

One of the constraints of the methodology with the AI model is it has less ability to differentiate a tree where it is in the shadow of a building, so trees may be missed and low vegetation shrubs less than 3 metres in height maybe included in the overall coverage results so the final results will vary from those results that were derived from LiDAR data in the council Technical Report 2020/009-2 April 2021 [4].

The aerial imagery analysis work includes the trailing of the use of a specific model to define individual trees' so segmenting each tree canopy within a stand and being able to provide a count on the numbers of trees that were analysed in the process.

The results produced by this type of machine learning analysis in this report should be treated <u>with caution as early estimates only and should not be quoted in a public forum as final results.</u>

An early assessment of the changes that have been reported through the AI analysis has highlighted that a large number of the

[4] *https://knowledgeauckland.org.nz/media/2066/tr2020-009-2-aucklands-urban-forest-canopy-cover-2013-2016-2018-revised-april-2021.pdf*

changes (loss) in tree cover at a local scale were occurring as a result of land use intensification on site.

The analysis work of aerial imagery will continue over the next 6 months and a final regional report on the canopy cover change reported later in 2024. The final canopy cover change results for Devonport Takapuna will be updated as part of the final reporting process.

3.0 Results and Discussion

The following analysis of LiDAR derived canopy coverage has been applied at a regional scale using the boundaries of the 21 Local Boards in Auckland; and additionally at a more local scale using Statistical Areas (SA2). The SA2's are part of the national census data and they have been applied to ensure consistency across the various data sets.[5] The tree canopy cover estimates by SA2 area for Devonport-Takapuna are shown in Figure 1.

3.1 Tree Canopy Cover in Devonport-Takapuna Local Board

Tree canopy covers 16% (342 ha) of the Devonport-Takapuna Local Board area (2100 ha) based on 2016-18 LiDAR estimates. This is average compared to other predominantly urban Local Boards in the region (Table 1), and only 1% above the minimum target of 15%; that is set out as an objective of the Urban Ngahere Strategy. This strategy has a high level action of achieving an average 30% canopy cover across all urban Auckland, with no Local Board area having less than 15% cover.

Overall, the data analysis indicates there was no net change in canopy cover in the Devonport-Takapuna Local Board area between 2013 and 2016-18 estimates (Table 1).

[5] https://datafinder.stats.govt.nz/layer/106728-statistical-area-2-2022-generalised

Table 1: Percentage extent of net canopy cover by predominantly urban local board and land tenure for the years 2013 and 2016-18

Local Board	2013	2016-18
Kaipātiki	30%	30%
Upper Harbour	27%	28%
Hibiscus and Bays	25%	24%
Albert-Eden	20%	20%
Puketāpapa	20%	20%
Ōrākei	20%	19%
Waitematā	19%	19%
Whau	17%	17%
Devonport-Takapuna	16%	16%
Howick	16%	16%
Henderson-Massey	15%	15%
Papakura	13%	14%
Manurewa	12%	13%
Maungakiekie-Tāmaki	11%	12%
Ōtara-Papatoetoe	9%	10%
Māngere-Ōtāhuhu	8%	8%

As an overview, the initial analysis contained in this report (in line with the Urban Ngahere (Forest) Strategy) shows where tree planting and/or efforts to incentivise retaining existing trees could be concentrated, while there are also areas that are lacking in urban canopy.

- The Urban Ngahere (Forest) Strategy has a high-level objective to help all Local Boards achieve a minimum tree canopy cover of 15%. Further efforts to increase tree canopy cover on public land and within the road corridor will increase the benefits that communities receive from established trees and canopy coverage in their local area.

There are good indications that tree canopy coverage in public ownership is increasing; the net extents of tree canopy coverage in the period from 2013 to 2016-18 increased by 3% on public open space land and 2% within the extent of the road corridor (roads and unzoned land). These percentages equate to an overall increase in tree canopy cover area by 5.5 hectares on public park land and 6.9 hectares within the extent of land zoned as road corridor. The net increases in tree canopy cover are encouraging and display an improving trajectory for the overall net extent of tree canopy cover on public land.

The analysis of the data to establish the area of tree canopy coverage is only a part of the overall assessment of the make-up of the urban forest in a particular area. The mixture of species, the various height differences with each individual tree and overall health are other metrics that help inform our understanding. Council is focusing on better understanding individual tree health across Local Boards areas. A database has been developed to record the details of trees on council land and this enables details on the trees' health and condition to be captured.

The data captured by aerial LiDAR is processed to extract details on the area extent and height of tree canopy representing individual and groups of trees. The results of this processing are further analysed in the following sections on tree canopy distribution (3.2) and height classification (3.3).

The ngahere is not distributed evenly throughout the Local Board area, as shown in Figure 1, and 2, tree canopy cover ranges from 13% to 23% across 19 statistical areas. More than half of the Local Board's statistical areas have less than 20% urban ngahere cover. This includes four with less than 15% (Takapuna West, Westlake, Forrest Hill West, Milford West). These low canopy cover areas typically feature arterial roads. Despite benefiting from the remnant eastern section of Smith's Bush, Takapuna West has the lowest canopy cover in the Devonport-Takapuna Local Board area.

The highest canopy cover by statistical area is in Takapuna South, a predominantly residential area that includes tree lined cliff tops and beach front and features extensive vegetation at St Leonards Chapel and Gardens. There is a network of greenspace that helps provide canopy cover along the Takapuna Cycle Route. Greville Reserve (Forest Hill), Smiths Bush (East), Takarunga / Mount Victoria and Maungauika / North Head all support important pockets of native and exotic vegetation providing habitat for a range of avian species.

Gaps in the ngahere exist across the majority of statistical areas. This is largely due to extensive grasslands typical of sports fields such as Toharoto Park and Ngataringa Sports fields, and open reserves such as the closed landfills at Barry Point Reserve (including the Golf Practice Range) and Ngataringa Park. This is also true for school sports fields and other publicly owned land such as Rosmini College, Westlake Girls and Westlake Boys High Schools, Takapuna Grammar School, Smales Quarry and the North Shore Hospital site.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

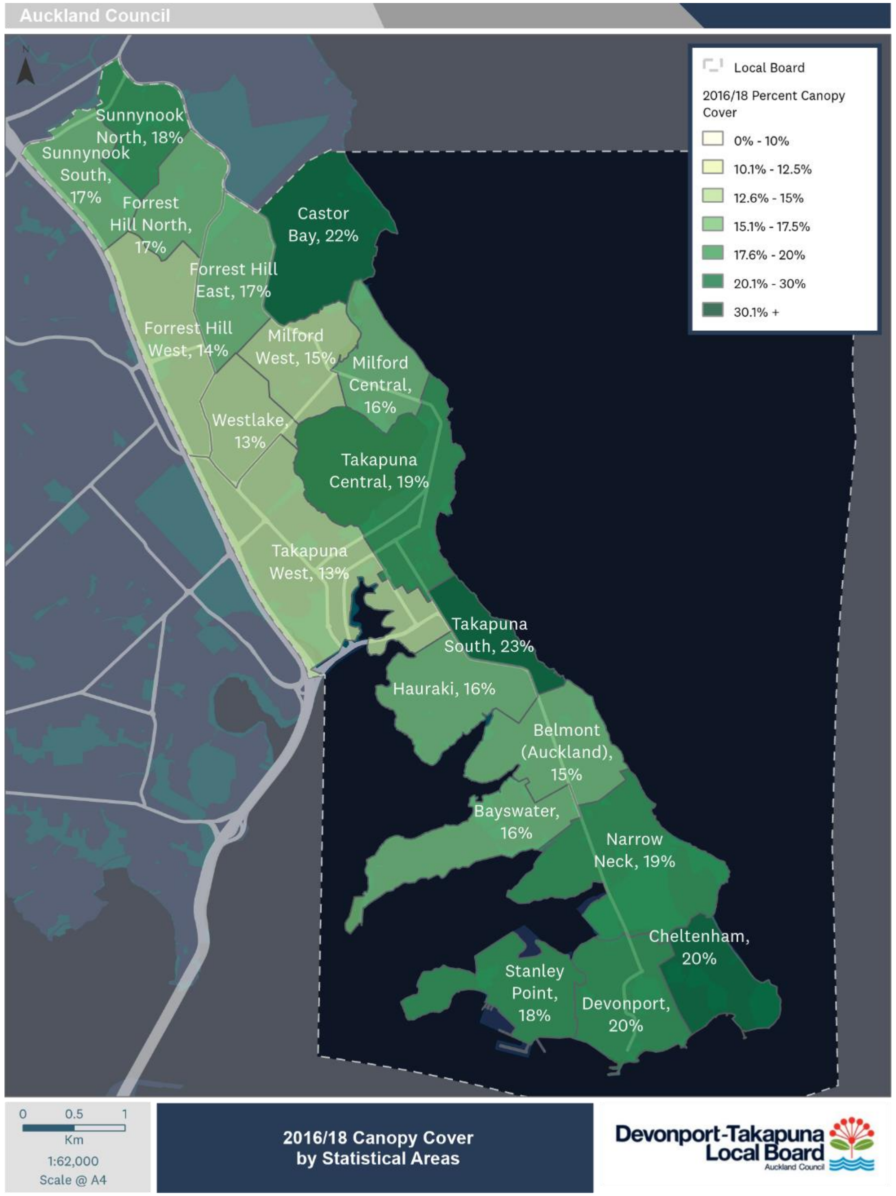


Figure 1: Percentage of tree canopy coverage derived from 2016-18 LiDAR by statistical area (SA2)

Increases in overall canopy between the two datasets are most apparent in Sunnynook South, Bayswater, Takapuna South, and Takapuna West. This increase is likely due to the growth of vegetation in road corridors, such as plantings along the Northern Motorway, and commercial office parks such as Smales Farm.

Three statistical areas showed decreases in overall canopy cover between 2013 and 2016/18. The most significant was the Castor Bay area (24% cover in 2013 to 22% in 2016/18), attributed mainly to infill developments on private land. To a lesser extent net decreases also occurred in Westlake and Milford West. These were also attributed to development on private land.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

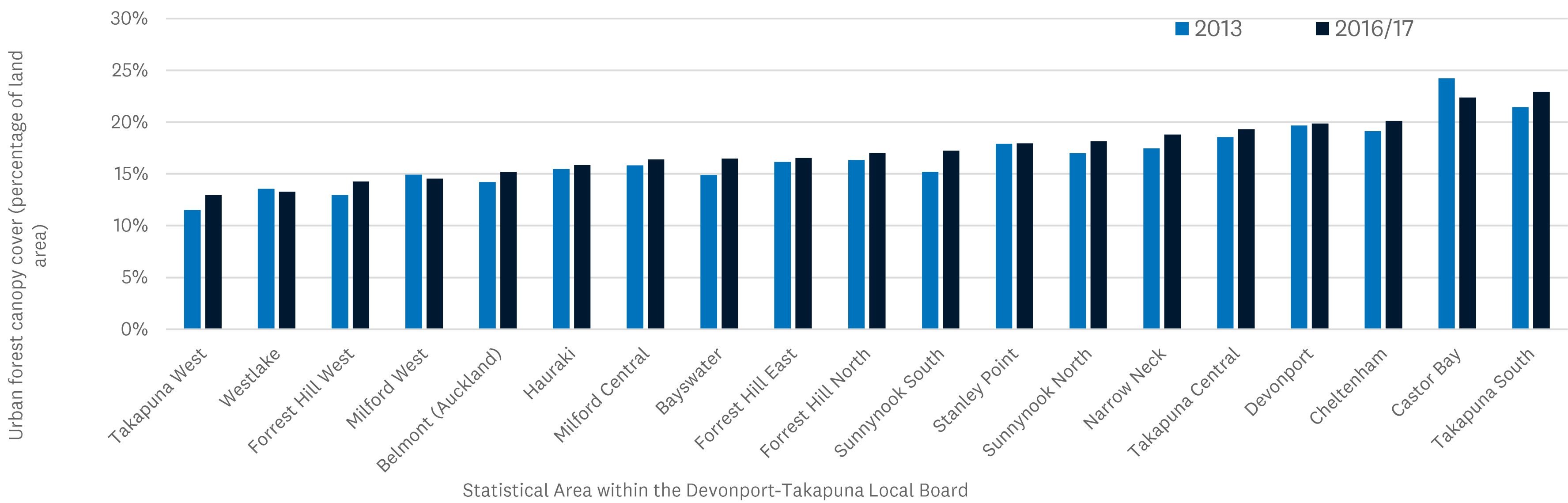


Figure 2: Percentage canopy cover by statistical area (SA2) in 2013 and 2016-2018 (derived from LiDAR)

3.2 Tree Canopy Height Distribution

The LiDAR data allow for understanding height of canopy throughout the Devonport-Takapuna Local Board.

This data is representative of tree canopy cover height, rather than individual tree height, as individual trees may be recorded across several height categories. A variety of sizes that make up the urban forest canopy is important to ensure overall sustainability and longevity. Having too many old or too many young trees should be avoided.

Tree height varied between 3-5m to less than 30m (Figure 3). In 2013 approximately one-third of the canopy cover is in the 2-5 metres category, half in the 5-10 metres, and the remaining represented in 10 metres or greater categories. The majority of tall trees were found in clusters within parks, along tree lined streets and remnant bush areas.

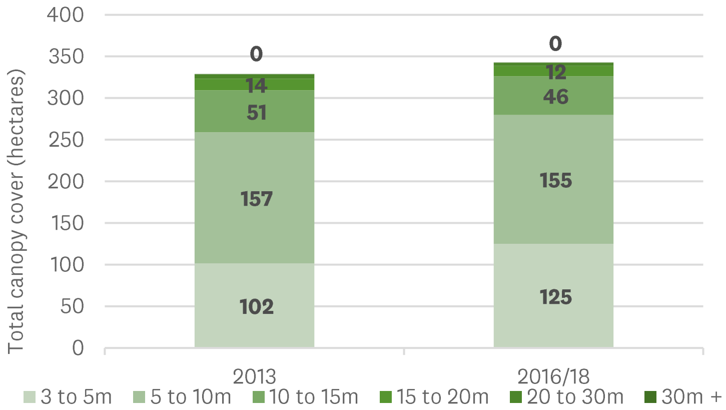


Figure 3: Graph to show the changes in the percentages of trees that were recorded in various different height classes

The height distribution was similar in the 2016-18 dataset with the largest shift in canopy cover identified between 3-5 metres with an increase of 23 hectares. This potentially indicates that the establishment of new tree plantings over the last decade is helping to increase the overall extent of tree canopy cover in the area.

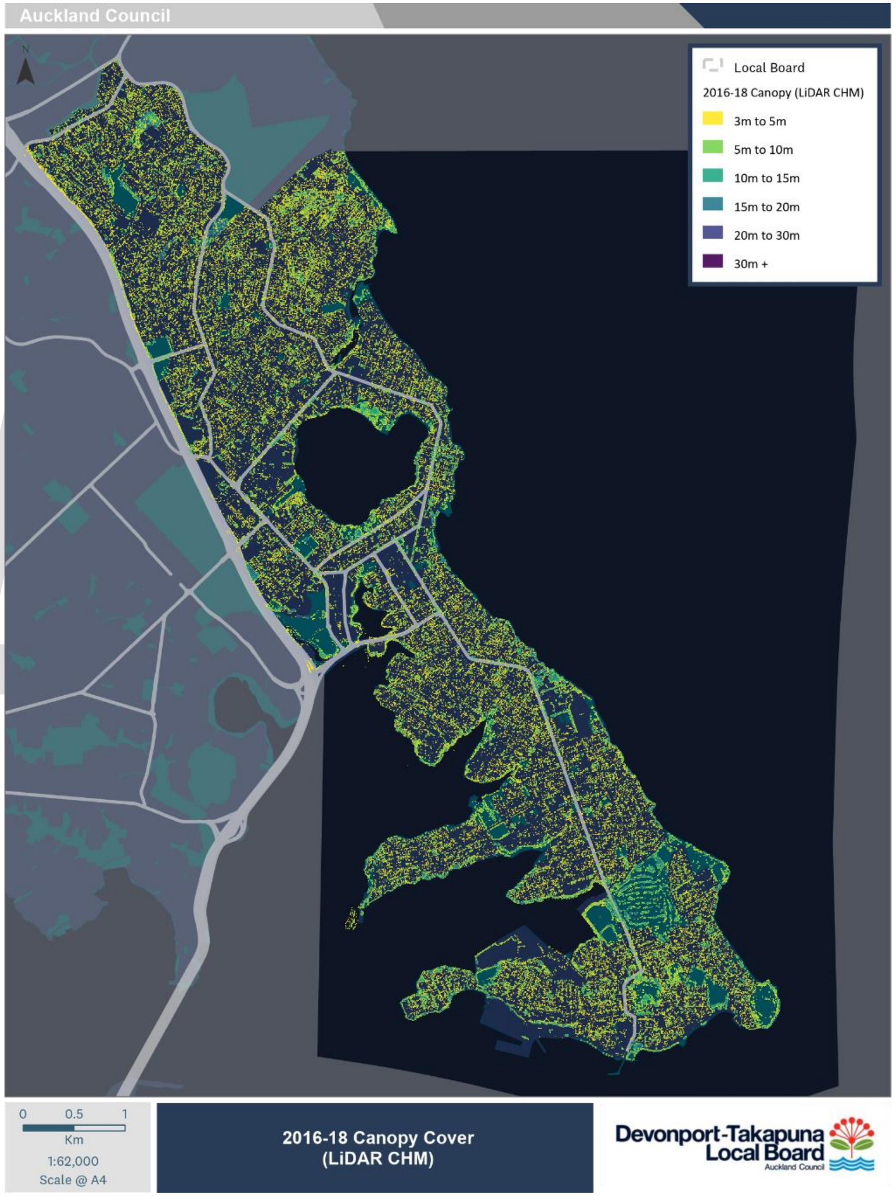
The data shows a low presence of tall canopy within the area, with all cover greater than 15 metres (including height categories 15-20, 20-30, and 30m+) representing approximately 5% of the total canopy cover assessed. In particular, the data shows a low presence of canopy in the 30 metres and over height category (less than 1 hectare), typical of most urban Local Board areas in Auckland.

The largest reduction in canopy area occurred in the 5-10 metres class and is of concern as they were widespread and not clearly associated with large scale activities. Research on tree canopy cover change in Auckland, for example in the Waitemata Local Board area (Lawrence and Bishop, 2018) found that most of the tree removal took place on private property and in over half of these cases there were no obvious reasons for the removal of the tree such as development, infill housing, building extensions, or swimming pool installation. This will become clearer when we have additional timestamps and can identify activities associated with tree removals.

A recent study of new developments across Auckland found the majority of vegetation (>95%) is cleared (reference to be confirmed). It is anticipated that intensification will continue to erode the numbers of large trees on private land within the Devonport-Takapuna Local Board area. The only controls that Council can apply to trees on private land are those that are listed as Notable trees in Schedule 10, and trees within areas listed in Schedule 3 as Significant Ecological Areas in the Unitary plan.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

No clear connection has been found between the removal of tree protection and the increases in the frequency of tree removals, however the removal of large trees from private property is going to impact the total extent of the tree canopy cover of an area.



3.3 Tree Canopy Cover by Tenure

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

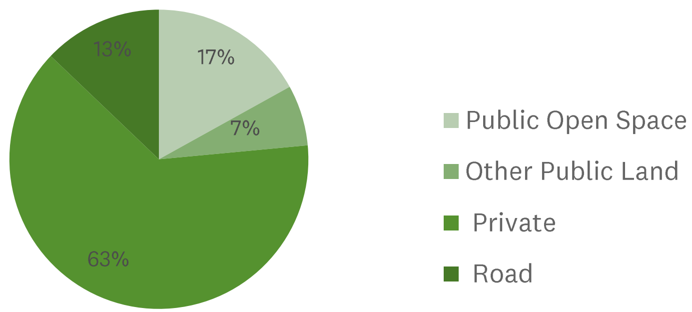


Figure 4: Proportion of total canopy area in each tenure within the Devonport-Takapuna Local Board (derived from 2016-18 LiDAR)

As shown in Figure 5, public parks have the highest proportion of urban cover relative to area out of all tenures, followed by private land. The results show there has been an increase in urban ngahere across all public land tenures between the two estimates. The percentage canopy cover of private land has stayed the same.

It is encouraging to see a significant increase in public park cover, especially as ngahere cover on public parks in the area has below average cover when compared to other urban Local Board areas.

The proportion of total canopy cover within each tenure class in the Devonport-Takapuna Local Board is displayed in Figure 4. Over half (63%) of the canopy is located on private property, which is reflective of the area being predominantly residential. Other public land (e.g., schools) and public open space contain similar proportions, being 13% and 17% of the total canopy cover respectively.

The increase in urban ngahere cover in public parks, and roads from the most recent data indicates that initial actions to increase the canopy cover are proving to be successful, along with retention and growth of existing ngahere. Despite making up 17% of the total land area across the area, street trees have a lesser role in the provision of ngahere (13% cover). This is average compared to other urban Local Board areas.

The recommendation to address this is to protect, wherever possible, existing street trees, and increase efforts to establish new street tree plantings. This metric provides direction on where tree planting efforts could focus; there is an opportunity to work with the local communities to seek input into the types of trees that could be planted to increase tree canopy cover on public and privately owned land.

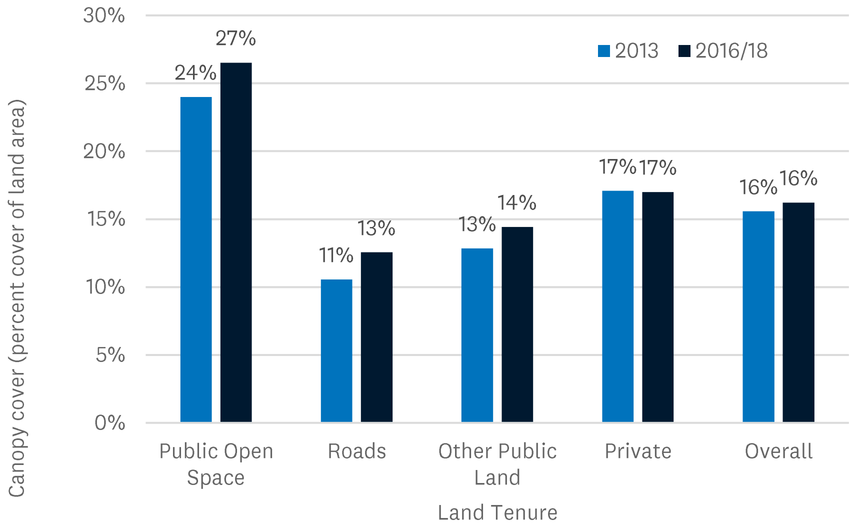


Figure 5: Difference in tree canopy cover of different land tenures in the Devonport-Takapuna Local Board between 2013 and 2016-18 (derived from LiDAR)

3.4 Tree Canopy Cover in Relation to Growth Pressures

No aerial data.

The significant ecological areas (SEA) are identified as having the highest ecological value, aiming to protect and better provide for the management of areas that contribute significantly to Auckland's biodiversity.

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Figure 6 shows the SEAs in the Devonport-Takapuna Local Board. These areas can serve as an initial point to prioritise the protection of urban ngahere. However, with urban expansion and intensification, SEAs and other continuous areas of urban ngahere are at risk. The tree canopy cover in relation to the Auckland's Future Development Strategy (Auckland Council, 2023) forecasting areas of growth has also been included in

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Figure 6.

Future development will occur in the Sunnynook and Takapuna Development Areas. Much of the land earmarked for development is zoned for more intensive residential development, including 'Residential – Mixed Housing Urban' and 'Residential – Terrace Housing and Apartment Buildings'. Converting existing residential properties into the new land use has the potential to see great loss of urban ngahere, particularly regarding trees that can be removed as a permitted activity (i.e., trees that have no protection status). For trees that do require resource consent for removal, the effects may be relatively small when considered on an isolated basis, however, when considered on a cumulative basis the effects may be large. When evaluating the ecological implications of tree removal, it becomes evident that the aggregate effects extend beyond the parameters typically examined in a standard application process. This is of particular concern for taller trees, as replacement plantings will take many decades to reach the same height and associated benefits as the canopy cover that has been lost. As such, the Urban Forest Strategy (Auckland Council 2019) aims to limit loss of percentage of trees larger than 10 metres tall.

Correspondingly, incorporating tree planting in new developments will become essential in retaining and increasing urban tree canopy cover throughout the area. A long-term focus on urban ngahere enhancement of public parks will make these more attractive for local residents who will have progressively less open space on private properties as intensification continues.

It will also likely be necessary to implement non-regulatory rules in addition to Auckland Council's regulatory tools that act to protect the urban ngahere. Since the removal of blanket tree protection rules, non-regulatory tools will become increasingly important to control the removal of trees and vegetation, particularly on private properties. Examples include landowner advice and assistance with tree care and planting, community education and outreach programmes, and raising awareness of the value and benefits of the urban ngahere. These tools, if implemented effectively, will help to instil pride for privately owned trees which will reduce the risk of these being removed for future development or otherwise.

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Figure 6: Auckland Unitary Plan Significant Ecological Areas and sequencing and timing of growth. Development areas have indicative sequencing based on major infrastructure, crown investment and development readiness.

3.5 Tree Canopy Cover and Heat

Vegetation and canopy cover plays an important role in mitigating surface heat across urban landscapes by cooling factors such as evapotranspiration (plants release water to the surrounding air, dissipating ambient heat and cooling air temperatures) and shade provision (tree canopy capacity to intercept thermal radiation from roads). The latest Auckland climate projection report (Lorrey et al. 2018) describes a trend in towards higher temperatures, increasing by up to 3.75° Celsius by the end of the century.

To illustrate the role of vegetation on surface temperatures across the area we plotted canopy cover (derived from 2016-18 LiDAR) for each statistical area (SA2) against land surface temperature (2016) derived from satellite measurements (Figure 7). Despite the scale limitations in the data[6] this analysis shows that there is a weak negative correlation between the two (r = 0.24). That is, areas that have higher canopy cover also have lower temperatures.

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Figure 7: Relationship between land surface temperature (derived from thermal satellite data, Landsat 8 OLI/TIRS, 11 September 2016 at 10:06 AM) and canopy cover (derived from 2016-18 LiDAR).

Many other factors, such as proximity to large water bodies (lake or coast) and the number of low-albedo surfaces will also play a role. For example, areas such as Takapuna West have relatively low canopy cover but also have a relatively high proportion of road area typically surfaced in low-albedo black asphalt, likely amplifying contributions to urban heat.

To understand the degree to which people are susceptible to the negative health effects of heat we also compared canopy cover (2016/18) for each statistical area against the Heat Vulnerability Index Rank (2018), developed by Auckland Council (Joynt and Golubiewski, 2019). This shows that areas with lower canopy cover are also associated with areas of higher risk of negative impacts of heat.

Note: Not everyone living in a high-vulnerability area is vulnerable and not all vulnerable people live in areas of high-vulnerability

[6] The different spatial scales between the thermal data (30m resolution) and canopy area (1m resolution) dilute the relationship as the effects of canopy cover on temperature are averaged out over the 30m observation. Excludes Takapuna Central due to the influence of Lake Pupuke on the land surface temperature at the Statistical Area unit scale.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

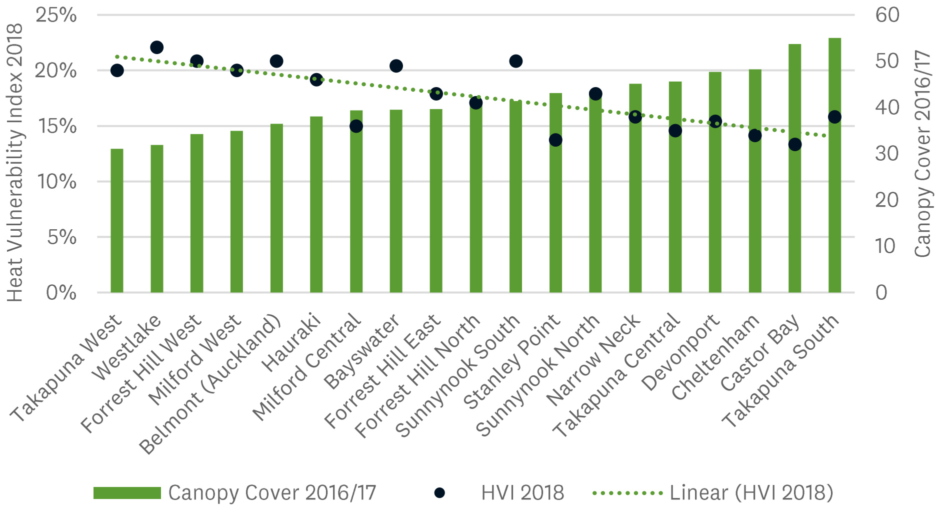


Figure 8: Heat vulnerability indexes applied to Statistical Area (SA2) compared to canopy coverage in 2016/2018

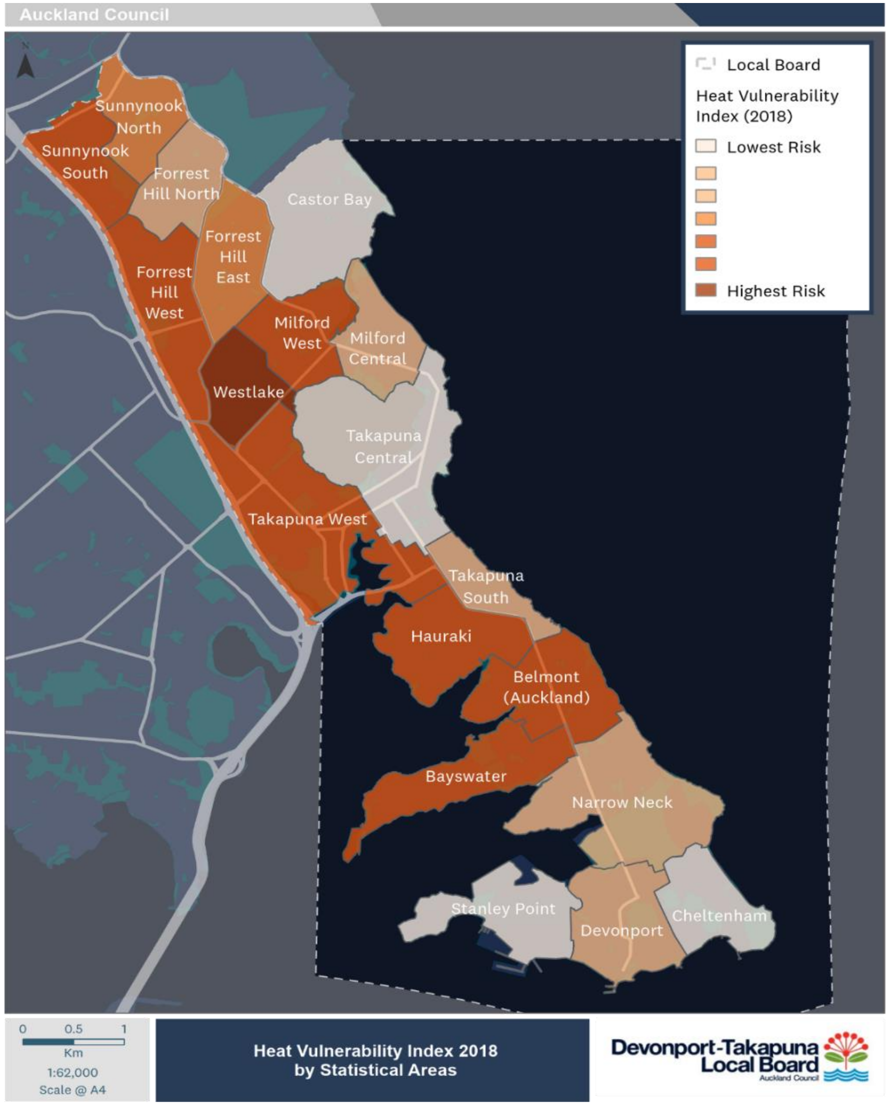


Figure 9: The heat vulnerability index based on 2018 data (updated from Joynt and Golubiewski, 2019) across Devonport-Takapuna Local Board

3.6 Tree Canopy Cover and Social Equity

LiDAR data set from 2016/2018 used for IMD analysis and aerial AI analysis technique used in playground case study.

There is extensive evidence to support that access to trees and nature can improve physical and mental health, foster community cohesion, and promote overall wellbeing and quality of life. These benefits are particularly crucial to socially disadvantaged areas where resources and opportunities are often limited as they amplify the transformative role trees can play in the lives of individuals and communities.

In the Devonport-Takapuna Local Board area, the relationship between the New Zealand Index of Multiple Deprivation 2018 (Exeter et al., 2020) and tree canopy cover is shown in 10.

Despite a weak negative relationship, it suggests that neighbourhoods with higher levels of canopy cover tend to experience lower levels of social and health deprivation. This finding highlights the potential benefits of urban trees in improving the overall wellbeing of communities in the areas. However, further research is needed to understand the specific mechanisms behind this association.

Building upon this evidence, it becomes clear that targeted interventions are needed to ensure equitable access to trees, green spaces, and associated benefits. Locally strategic planning programmes should be implemented to increase planting efforts to increase the tree canopy cover in areas with a relatively high level of deprivation.

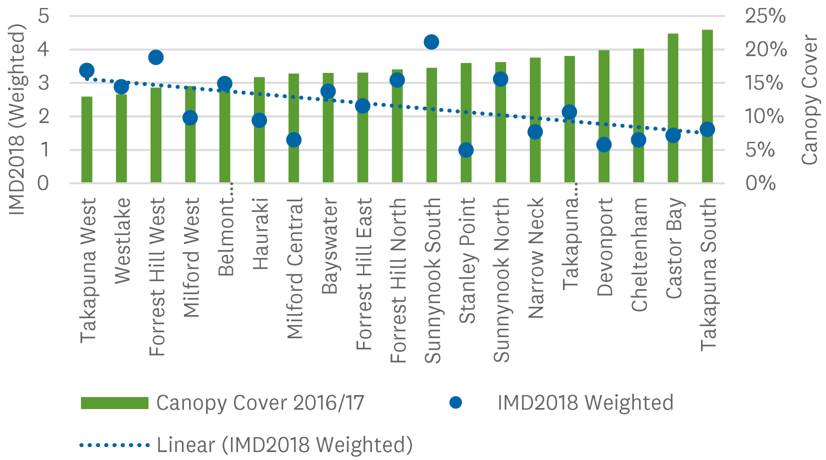


Figure10: Canopy cover and New Zealand Index of Multiple Deprivation 2018 (IMD2018) by Statistical Area 2

Figure 11 illustrates the variations in the index that occur across the local board areas and SA2. Meanwhile, it is important to retain and protect trees within future development areas such as Sunnynook South. By taking these actions we can address the disparity in access to urban ngahere and create an environment where all individuals and communities can thrive, regardless of their socio-economic circumstances.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

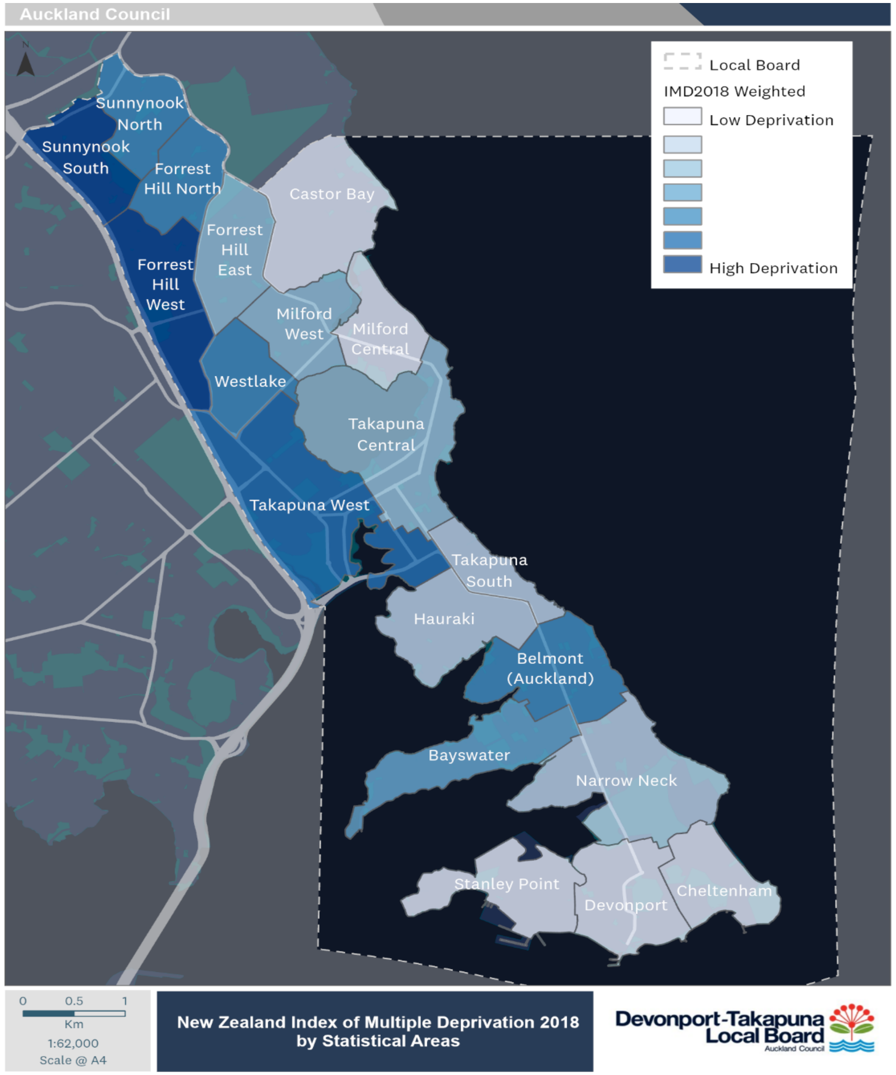


Figure11: The levels of New Zealand Index of Multiple Deprivation 2018 (Exeter et al., 2020) by Statistical Area 2.

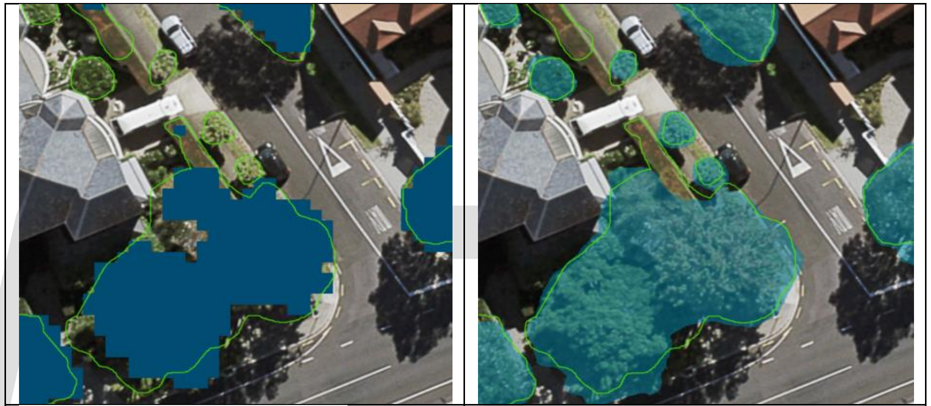
3.7 Case Study – Use of Machine Assisted Techniques (AI)

3.7.1 AI imagery canopy cover mapping

The current approach for acquiring tree canopy cover data involves using LiDAR data, which was available for the years 2013 and 2016/18. However, due to limited frequency aerial LiDAR surveys Auckland Council is actively exploring alternative approaches using different data sources. To efficiently address the need for cost-efficient and up-to-date canopy change monitoring, we have identified aerial imagery and artificial intelligence (AI) techniques as a promising solution.

In July 2022, the Ngahere AI project was launched with Auckland Council's ICT/Geospatial team. The project uses one of the latest AI techniques known as deep learning to assist repetitive canopy cover monitoring. This advanced model has been trained to accurately delineate canopy cover from aerial imagery. Our initial testing results have demonstrated its ability to approach human-level accuracy for city scale canopy extraction. The model also exhibits strong generalisability, allowing it to efficiently process future aerial imagery for canopy extraction with minimal adjustments.

It's important to note that the two approaches will produce different canopy cover estimates and accuracies for the same time period, due to differences in methodology and canopy definitions. The LiDAR-derived canopy only includes vegetation 3 metres and greater in height, whereas the aerial-derived canopy aimed to delineate all wooded areas, encompassing trees irrespective of height thresholds, and potentially including shorter vegetation such as shrubs and bushes. Compared to LiDAR-derived results, the imagery-derived canopy cover output is a significantly finer scale with a spatial resolution of 7.5 cm/pixel, as opposed to the 1 m/pixel map produced from LiDAR data (Figure 10). However, due to the 2D nature of aerial imagery, it cannot offer 3D information such as canopy height, which is obtainable from LiDAR data.



LiDAR canopy (CHM)	Aerial AI
The CHM has a resolution of 1m/pixel. As a result, the canopy edges are less smooth than the Aerial AI canopy. Due to the exclusion of vegetation below 3 metres, some street trees were excluded in LiDAR.	The aerial canopy has a resolution of 0.0075m/pixel, which provides smoother delineation on crown edges. It also detects trees that may be less than 3 metres in height

Figure 10 Imagery showing how LiDAR and Aerial AI measure tree canopy extent

The latest results of the 2017 and 2022 aerial imagery-derived canopy data using the AI approach were delivered in June 2024 and Figure 12 shows the canopy cover for Devonport- Takapuna.

Figure12: Distribution of canopy cover in Devonport-Takapuna Local Board, derived from 2017 aerial imagery. Includes all vegetation excluding, hedge rows and grass.

3.7.2 Accuracy of AI derived canopy cover

The accuracy of AI derived canopy cover was assessed by comparing with human delineated outputs. We selected 76 sample plots, with each plot has a size of 38.4m×38.4m, across the Auckland urban region and then manually delineated the canopy cover for referencing. Compared with human delineations, the 2017 AI results show an overall accuracy of 93.28%, along with precision and recall scores of 93.69% and 93.28% respectively. This suggests that the model is capable of accurately identifying a large percentage of positive cases (tree areas) while maintaining a low false positive rate (non-tree areas). The results are very promising and confirms the suitability and reliability of the technique.

In contrast, the LiDAR CHM demonstrated a lower overall accuracy of 86.8%, with a precision of 93.3% and a recall of 52% when compared with human delineated results. However, it should be noted that these LiDAR CHM figures are meant to illustrate differences in behaviour compared to the AI aerial approach, rather than to evaluate LiDAR CHM's accuracy against ground truth. Since the manually delineated reference data lacks height information, it cannot filter out low vegetation as the LiDAR CHM does. Thus, the accuracy of the AI derived canopy cover reflects how closely the AI performs compared to human outputs, while the LiDAR accuracy should only be used to understand the differences between the two approaches. An early comparison between these two results is shown in Figure 10. The LiDAR CHM and AI derived canopy cover showed agreement on tall trees, while the AI-derived canopy cover also included canopies that are likely lower than 3 meters and showed smoother delineated boundaries due to using higher resolution aerial imagery.

In addition, it is important to note that the LiDAR (CHM) data was captured in 2016, whereas the reference data was obtained from 2017 aerial imagery. Given that it is likely there may have been changes to the canopy cover during this period, such as the removal of trees after the LiDAR (CHM) data was captured, the lower recall score may be attributable to these changes.

Overall, the AI model demonstrates an ability to provide canopy cover with a high level of confidence, especially when measuring 2D canopy covers. Given the differences between LiDAR and aerial imagery, we found the AI-derived canopy cover to be a valuable complement to our previous monitoring methods. The AI outputs generally align well with LiDAR data, despite some disagreements on low vegetation. Moving forward, our efforts will concentrate on refining the model for wider applications on other aerial imagery, primarily on those from 2022 and 2023/2024. Subsequently, we plan to conduct a thorough comparison between the years 2017, 2022 and 2023/2024 to offer a more comprehensive assessment of canopy change over this five-year period.

3.7.3 Changes in Devonport-Takapuna Local Board Canopy Cover

For Devonport local board, we have finished canopy cover extractions from both 2017 (council aerial imagery) and 2022 (imagery purchased from Nearmap under licence) aerial imagery, which allows us to compare the changes in this 5-year time span.

Following previous analysis, the canopy cover changes were compared from three perspectives: *a. Overall area changes, b. Area changes by land use type (tenure) and c. Area changes by statistical units from NZ census (statistical area).* In addition, we are exploring an application analysis for playground shading using these AI-derived products.

a. Overall area changes

The overall area experienced a minor reduction between 2017 and 2022, with a loss of 1.99 hectares and a 0.1% decrease in coverage. Although the total area change appears minor during this period, significant losses (e.g. property redevelopment) and gains (e.g. tree growth) in specific areas were observed. These changes balanced each other out, resulting in a minimal net difference in the total area. More in-depth discussions are provided in the following sections.

Table 2. Overall area changes between 2017 and 2022

AI-derived canopy	2017	2022
Canopy cover area (ha)	460.4073	458.4211 (-1.9862)
Canopy cover percentage	22.97%	22.87% (-0.1%)

b. Area changes by land use type (tenure)

The canopy cover areas were further analysed by land use types, revealing varying changes in canopy cover percentages. Roads and parks saw minor increases in coverage by 0.3% and 0.1%, respectively (Table 3). In contrast, private land and POL (public other land) experienced decreases of 0.3% and 0.1%, respectively. We concluded that the losses were closely linked to redevelopment activities occurring on these land types. An example is shown in Figure 11.

Table 3 Canopy cover by land use types

Tenure	2017 AI canopy	2022 AI canopy
Other	0.1%	0.1%
POL (public other land)	6.1%	6.0% (-0.1%)
Parks	15.4%	15.5% (+0.1%)
Private	66.0%	65.7% (-0.3%)
Road	12.4%	12.7 (+0.3%)

Figure 11 Canopy losses caused by property redevelopment

Apart from these larger-scale tree canopy cover losses, many individual trees and small groups of trees were removed during the two time periods.

While the reasons for these losses were not specifically considered for this report (investigation following completion of data), previous research suggest that a myriad of functional, social, aesthetic and environmental factors may contribute to the removal or loss of tree canopy cover.

Canopy cover gains were also evident, with large areas of plantings visible (examples Include Northern Motorway planting). There are also extensive restoration plantings throughout the local board, that will undoubtedly be identified in future canopy cover mapping work.

When examining the net change in areas, private land saw a net loss of 2.64 hectares, followed by POL. It is noteworthy that despite gains in parks and roads, there was still a net loss in total canopy area, reflecting the significant changes on private lands."

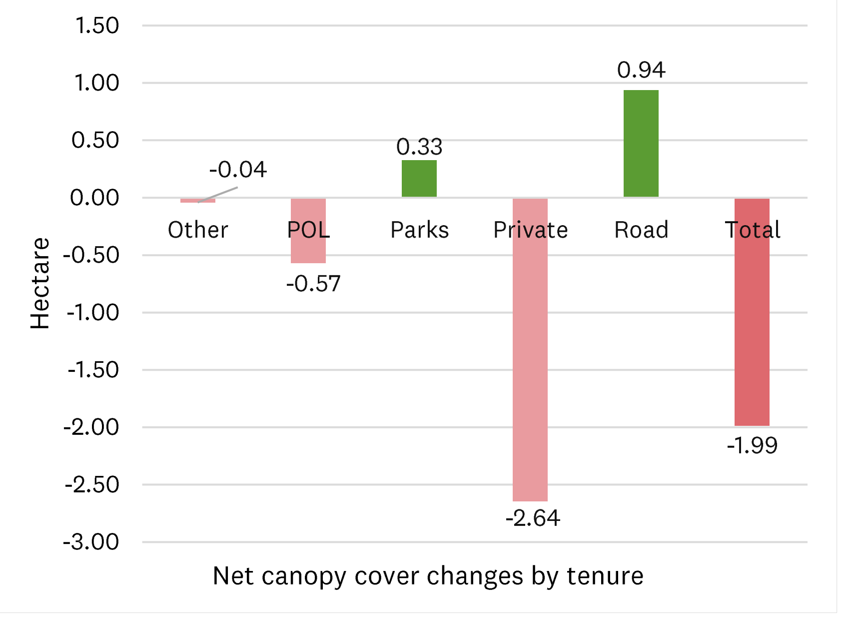


Figure 12 Net canopy change by land use types (after compensating for Losses and Gains)

c. Area changes by statistical units

When splitting the canopy cover by SA units, different communities experienced varying changes. Areas that saw decreases in canopy cover percentage include Takapuna South, Takapuna Central, Stanley Point, Belmont, and Forest Hill West (Table 4).

Table 4 Table 3 Displays the net canopy coverage results produced by Aerial Imagery in 2017 and 2022 and LiDAR imagery from 2016 with vegetation over 3 metres and all

SA2 Name	2017 Canopy Cover	2022 Canopy Cover	2016LiDAR_abv3m	2016_LiDAR_all_veg
Bayswater	22%	22%	15%	28%
Belmont (Auckland)	21%	20%	15%	30%
Castor Bay	32%	32%	23%	43%
Cheltenham	26%	26%	20%	37%
Devonport	26%	26%	20%	39%
Forrest Hill East	23%	24%	17%	35%
Forrest Hill North	24%	24%	17%	33%
Forrest Hill West	20%	19%	14%	30%
Hauraki	23%	23%	16%	35%
Milford Central	21%	21%	16%	31%
Milford West	20%	21%	14%	31%
Narrow Neck	24%	24%	19%	32%
Stanley Point	23%	22%	18%	31%
Sunnynook North	26%	26%	18%	35%
Sunnynook South	25%	25%	17%	32%
Takapuna Central	22%	21%	9%	15%
Takapuna South	28%	27%	23%	42%
Takapuna West	18%	18%	13%	25%
Westlake	19%	19%	13%	30%
Total	23%	23%	17%	32%

Overall, this new approach enhances the measurement of finer-scale vegetation features and low-lying, non-structural vegetation in urban environments such as gardens, wetlands, and newly revegetated areas.

With improved definitions of canopy cover, we can better describe tree canopy (from LiDAR) and broader urban vegetation canopy (from imagery). Access to multi-year aerial imagery allows for more frequent comparisons and a better understanding of the impact of human activities on our urban forest. Using AI as an assessment technique will cost-effectively improve the frequency of reporting.

3.7.4 Tree canopy cover in playgrounds

Here we present the first findings from the Aerial Imagery extraction using the AI machine learning methodology.

Playgrounds play an immensely pivotal role in fostering and enhancing social equity within communities. Well-designed playgrounds can serve as inclusive hubs that bring together children and families from diverse ethnicities, backgrounds, and abilities. Consequently, playgrounds not only provide endless opportunities for fun and recreation but also serve as invaluable resources for behavioural, educational, and cognitive growth in children.

Aerial extraction has used here because it includes lower-stature vegetation, not included the LiDAR method.

The Devonport-Takapuna Local Board area features 37 playgrounds[7]Figure 15). Here we explore canopy cover on these playgrounds using vegetation extracted (using an AI approach) from aerial imagery. More details of the AI assessment tool are provided in section3.7. The benefit of using vegetation canopy from aerial imagery is the inclusion of low-stature vegetation (below three metres that is

[7] *Multiple playground plots within the same park boundary were counted once in this analysis.*

excluded from the LiDAR approach). The analysis results show that the canopy cover of the playgrounds in the area varies widely (Figure 14).

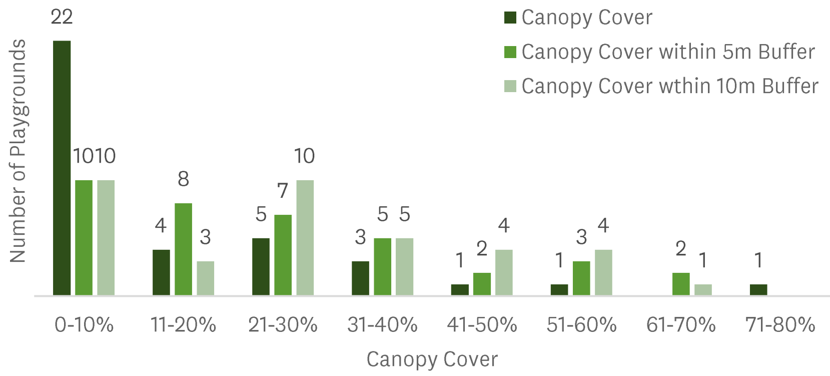


Figure 14: Number of playgrounds by canopy cover measured inside playground boundary, 5-metre and 10-metre buffered playground boundaries.

Figure15: Distribution of playgrounds in the Devonport-Takapuna Local Board area

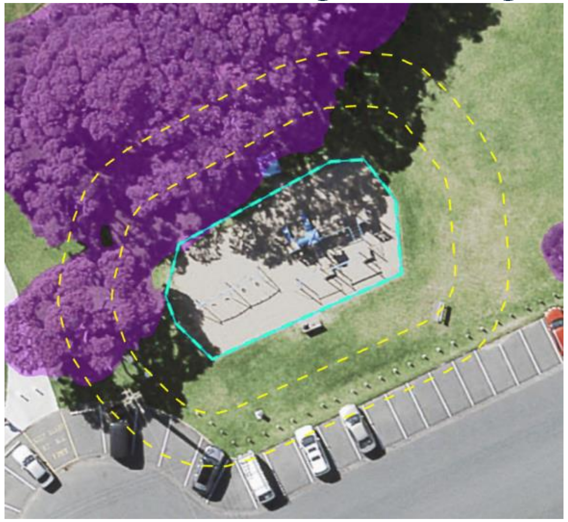
Trees are valuable assets in playgrounds by providing shade and protection from the sun's harmful UV rays as well as regulating the temperature to make the facilities more comfortable to play in. This is especially important for Auckland where UV levels are relatively high from spring to autumn. However, Figure over half of these playgrounds either lack any form of canopy cover or have less than 10% of canopy cover, potentially restricting their accessibility during scorching summer days.

Despite this, when a canopy cover analysis was conducting using both the 5-metre and 10-metre buffers around playground boundaries, the number of playgrounds with limited canopy cover reduced (Figure . This indicates that a large amount of canopy cover is provided around the perimeter of the playgrounds, which could potentially offer some relief from unfavourite weather conditions. The results also produce a useful data set that can aid in decision making on prioritising new tree planting efforts for shade provision.

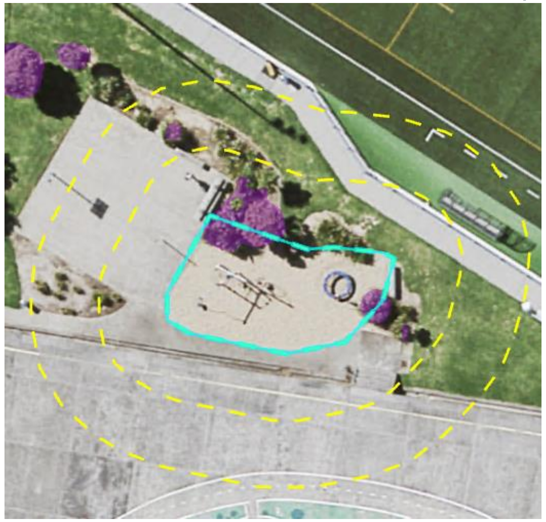
		Lat (S)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Darwin	AUS	12	12	13	13	11	9	8	9	10	12	13	12	12
Brisbane	AUS	27	12	11	10	7	5	4	4	5	7	9	11	11
Perth	AUS	31	12	11	9	6	4	3	3	4	6	8	10	11
Sydney	AUS	33	11	10	8	5	3	2	3	4	5	7	9	10
Adelaide	AUS	35	11	10	8	5	3	2	2	3	5	7	9	11
Canberra	AUS	35	11	8	7	5	3	2	2	3	5	7	9	11
Auckland	**NZ**	**37**	10	8	7	4	2	1	2	2	3	6	8	9
Melbourne	AUS	38	10	9	7	4	2	2	2	3	4	6	8	10
Wellington	**NZ**	**41**	9	8	6	3	1	1	1	2	2	5	7	8
Hobart	AUS	43	8	7	4	3	1	1	1	2	3	4	6	7
Christchurch	**NZ**	**44**	8	7	5	2	1	1	1	1	2	4	7	8
Invercargill	**NZ**	**46**	7	6	4	2	1	0	0	1	2	3	5	6

Figure16: Seasonal range of mean noon UV Index. The higher the value of UV Index, the higher the radiation level. Data derived from a research paper conducted by McKenzie (2017).

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

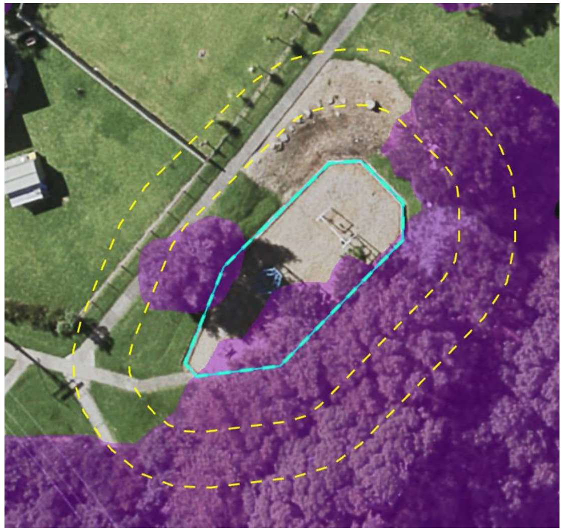


Milford Reserve (1% original canopy cover)

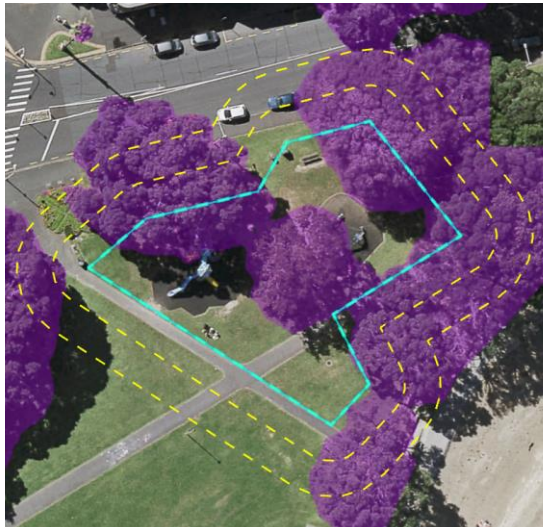


Greville Reserve (9% original canopy cover)

Devonport Domain (23% original canopy cover)



Plymouth Reserve (34% original canopy cover)



Windsor Reserve (48% original canopy cover)

Takapuna Rose Gardens (78% original canopy cover)

Figure17: Examples of playgrounds with canopy cover measured in original (blue polygon), 5-metre and 10-metre playground boundaries (yellow dashed polygon).

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

Only one fifth of playground facilitates[8] are directly shaded by trees in the area's playgrounds (Figure18). Shade is an important criterion when looking at long-term use of playgrounds by communities considering the higher levels of UV that occur in Auckland during the summer months. Therefore, to enhance the overall playground experience for children and families it is essential to increase shade.

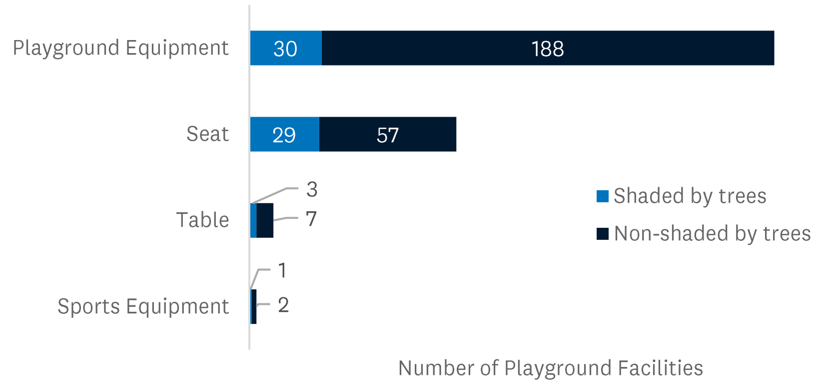


Figure18: Number of playground facilities in Devonport-Takapuna shaded or non-shaded by trees.

Improvements can be made by increasing the planting of specimen trees, especially tree species that naturally develop a wider crown canopy, in closer proximity to playgrounds. This strategic tree planting would offer various long-term benefits, including providing shade, cooling the area, creating play opportunities, offering habitat for wildlife, and contributing to carbon dioxide absorption while releasing oxygen.

While it may take several years for newly planted trees to provide shade, a short-term solution can be implemented through the installation of shade sails. These sails can serve the immediate purpose of providing shade and reducing direct sunlight exposure. However, it is important to acknowledge that shade sails come with ongoing costs, a carbon footprint, and require regular maintenance and replacement.

Considering the long-term perspective, trees are the preferred option as they increase in value over time, unlike hard assets such as shade sails which depreciate and eventually need replacement. It is advisable to prioritise tree planting alongside or instead of shade sails to ensure sustainable and environmentally friendly solutions for shade provision in the playgrounds.

[8] 10-metre buffer playground boundary is used to extract playground facility data.

3.8 Threats to Urban Tree Health

Animal pests, weeds and disease threaten the urban ngahere, including the precious pockets of native forest remnants that can still be found on public and private land.

The health of the individual trees that collectively make up the canopy coverage across the city is fundamental to ensure a flourishing urban ngahere. The Regional Urban Ngahere (Forest) Strategy outlines some of the risks that are impacting negatively on the health of individual trees. There are a number of known pests and diseases that are now affecting native and exotic trees across the region such as Dutch elm disease, Kauri die back, myrtle rust and the Ambrosia beetle.

Alongside the diseases and insect pests there are the browsing animal pests such as possums, rabbits, and rats that threaten the health and vitality of the urban and rural ngahere. Possums are an easily recognisable problem as they cause extensive browsing damage to trees and climbing weeds like honeysuckle wrap around branches and smoother or out compete with the growth of the host tree. However, insect damage and infection with a disease in trees is much more difficult to detect and in cases like the Dutch Elm Beetle it can go undetected until an infected trees shows symptoms, at which point it is impossible to treat the disease and under the Biosecurity Act infected trees should be removed and disposed of as soon as possible.

3.8.1 Kauri Die Back

Kauri Die Back is an example of a disease that is spreading unseen, through the soil in remnant stands of Kauri infecting and killing trees. The disease is a microorganism named Phytophthora ‘taxon Agathis’ (PTA) was first recorded on Aotea Great Barrier Island in 1976 and identified by NZ Forest Research pathologist Peter Gadgill. Since then, it has spread to the mainland and now occurs in various locations across urban auckland, the Waitakere Ranges, Coromandel Peninsula and Northland.

The disease pathogen is more commonly referred to as Phytophthora agathidicida (PTA) and its spread has had a catastrophic impact on a large number of trees. In a study conducted by Auckland Council on an area of the Waitakere Ranges between 2011 and 2016, it was determined that the rate of infection by the disease increased from 8% to 19%. There is a much better understanding of the disease pathogen now following several years of work by a large team of New Zealand scientists. There are no defined treatments for the disease, however there are a better range of control measures in place now to limit its spread, and work is ongoing to determine whether there are curative measures that can be taken to prevent the disease from killing infected trees.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

Figure19: Locations of Kauri Die Back cleaning and monitoring stations

Figure 19 shows the locations of trees that are of interest on the North Shore and the location of monitoring and footwear cleaning stations in local parks where kauri occur. These trees have been identified and recorded through ongoing survey programs and calls from the public to a council manged hotline. Soil sampling has confirmed a few of the trees recorded have been infected by the pathogen.

The Natural Environment Target Rate (NETR) funds a range of programmes that help to control pest animals pest plants and pathogens regionally and helps communities who want to take action in their local area. The initiatives aim to improve and create ecological corridors across the region to restore connections between different natural habitats in rural and urban landscapes.

The NETR programme provides a range of funding packages for plant pathogen pest management projects, including construction of kauri-safe tracks with cleaning stations, surveillance and monitoring to help understand where efforts need to focus to protect healthy stands of trees, and trialling treatments on those areas infected by the pathogen.

Council has a range of programmes with iwi and local community groups who volunteer their time to help trap animal pests and remove weeds from public, and in some cases private, land. The work of these groups is making a difference to the quality of the urban ngahere by removing pest species and planting native trees in local parks.

3.8.2 Myrtle Rust

Myrtle rust was first found on the East Coast of Australia in 2010, the disease arrived on infected cut flowers from central America and has now spread along most of the east seaboard of the country. It is believed the disease arrived in New Zealand via ex tropical weather systems in the summer of 2017, it was found on Raoul Island in March and In May of 2017 It was first found in Kerikeri, Northland and Taranaki, before being found on a property in West Auckland in November 2017. The disease has subsequently spread across large areas of the North Island and has been found across several locations in the South Island.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

Myrtle Rust is a fungal pathogen known as *Austropuccinia psidii*. It causes a range of problems to the growth of trees in the Myrtaceae (Myrtle) family, notably it infects leaves, shoots and flowers, and can cause infected stems to die.

There are 37 native members of the Myrtaceae family in New Zealand, and some of these are well known taonga species to Mana Whenua Pōhutukawa, rātā, mānuka, kānuka, ramarama and swamp maire are all members of the Myrtaceae family and are susceptible to infection by Myrtle Rust. Studies so far have shown that New Zealand natives in the Myrtaceae have varying levels of susceptibility and research work is ongoing to determine those that are more susceptible to infection. A range of exotic trees found in Auckland, such as *Eucalyptus* sp., bottle brush, willow myrtle, and feijoa also belong to the Myrtaceae family and have the potential to be affected by the disease. The number of distinct species in New Zealand that are susceptible to Myrtle Rust is still being researched.

Figure20: Myrtle Rust infected trees that have been found and reported to Council. (Image courtesy of Auckland Council)

The disease produces fungal spores which are carried generally by the wind and has now been observed on trees in the Waitakere Ranges, in the Hauraki Gulf on Rangitoto Island and Waiheke Island. Scientists expect the disease to continue to slowly spread across the North Island.

The disease is expected to continue its spread across the north and South Island and will only likely be restricted by local climatic conditions. It is anticipated the colder climatic areas of New Zealand (e.g., alpine areas) will have an influence of where spores can survive overwintering. The disease is only able to reproduce when daily temperatures are 19 degrees Celsius or greater.

The disease originates from warm climates, and it is expected its range will increase as the temperatures across the two islands increase over time. The map in Figure 21 shows the potential range in North and South islands' of the disease with current climate conditions and the risk of infection. Green shading indicates a lower risk, while pink and red indicate a higher risk of infection.

The disease is still in its early stages of development in New Zealand and the impacts long term on the amenity tree population and areas of native forest are not well understood. There are certainly risks to the viability of some species that are commonly planted on public and private land.

The map in Figure 21 show the geographic distribution of Myrtle Rust infection predicted by the Myrtle Rust Process Model. The maps were generated using virtual weather data supplied by NIWA. The model shows average annual risk (left) and maximum high risk (right) which occurs based on summer and autumn weather conditions (reproduced from Beresford et al. 2018).

Studies to date on native species has found that species such as Ramarama (Lophomyrtus bullata) and the exotic tree species Lilly Pilly (Syzygium australe) are very susceptible to infection. In the case of Lophomyrtus the cultivar 'Red Dragon' which is a commonly planted landscape variety has been found to be highly susceptible to the disease.

So far, the disease has been found on 49 different species of native and exotic tree species in the Auckland region. This number is likely to grow as the disease continues to spread.

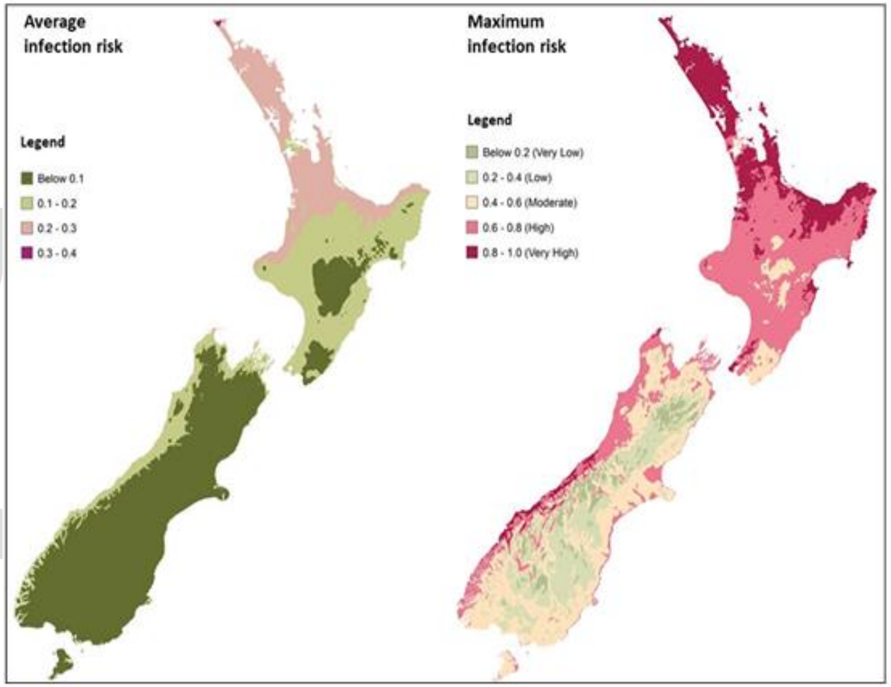


Figure21: Likelihood of Myrtle Rust occurrence based on climatic conditions

Myrtle Rust is an air borne disease that will continue to impact on Myrtle species in the short to medium term; however, there is a significant amount of government funded research taking place and Auckland Council has set up a local database (refer to Figure 22) to record the presence of the disease across the local board area. Auckland is one of many councils across New Zealand helping researchers nationally and internationally to understand and look for ways of controlling the effects of the disease on native and exotic species of trees.

Te matomatotanga o Te Ngahere-a-Tāone Te Rohe o Devonport-Takapuna

The process of data collection has meant the location, tree species, level of infection and whether it is a public or private tree needs to be recorded accurately. Ongoing, the field work will help council officers to track and record the presence of the disease and the types of trees it is infecting.

Auckland Council has an educational programme to provide landowners with options to manage Myrtles on their property.

Currently there is no cure for Myrtle Rust, however there are treatment sprays that can help control the disease on infected trees in a garden setting.

The disease is much harder to control in public parks and Council is trying to adopt maintenance measures that limit the spread. The Council is trailing options around when tree maintenance takes place on council owned trees to try and prevent disease spread, in some cases carrying out work in winter when the disease is at its least active. Tools and equipment used to prune trees in the myrtle family are cleaned using Sterigene or Methylated Spirits diluted in water, which can kill the disease spores and reduce the risk of inadvertent spread.

Myrtle Rust is a good example of one of the threats that exist to the unique vegetation found in New Zealand and the importance of biosecurity monitoring programmes at all of the points of international entry that exist in Auckland. The increasing flow of international freight and travellers to Auckland poses a significant threat to the ngahere, and in the last decade a number of pests and diseases have arrived that are now created problems with the health and vitality of the urban Ngahere across the region. Some have established populations before being discovered.

Myrtle Rust Surveillance 2022 - 2023 : Devonport Takapuna

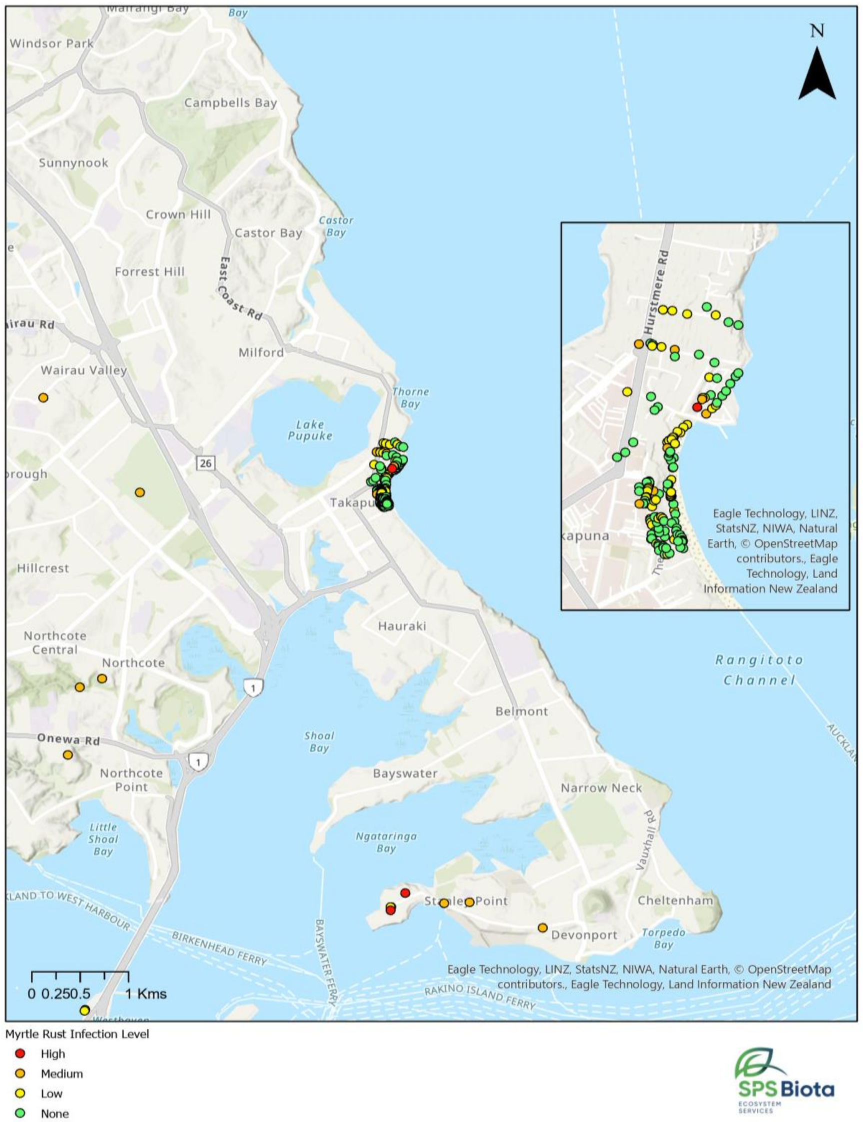


Figure22: The locations of trees reported and level of confidence the tree was infected with Myrtle Rust across Devonport Takapuna Local Board

3.8.3 Granulate Ambrosia Beetle

The Granulate Ambrosia Beetle (GAB) is one of a number of inspect pests that have been found in Auckland. It was first discovered in February 2019, and it was thought to have become established a couple of years before discovery. It was found in a sample collected from a Pin Oak tree in a council reserve in Blockhouse Bay. Subsequently It has been discovered and reported on a number of properties in West Auckland.

The adult beetle is very small, has the ability to fly and is known to infect over 100 species of amenity and fruit tree across 40 different tree and shrub families. It is considered a serious pest to ornamental tree species and fruit crops like avocado, peach and plum.

Research shows the beetle can have an adverse impact on the health of a tree it establishes a population in. The effects on native tree species are not known and work is being undertaken by Crown Research Institutes, Scion, and Plant and Food Research to increase the level of understanding of the range of host species the beetle establishes in, and the potential for long term effects on horticulture and forestry. The beetle nurtures a fungal colony in the tree which in many cases then negatively impacts on the tree's health and vitality.

3.8.4 Dutch Elm Disease (DED)

Dutch Elm Disease infects trees in the Elm family (Ulmaceae) and was first found in Myers Park in Central Auckland in December 1989. It is thought to have arrived in an infected wooden package that came through the port. The disease is caused by a fungus *Ophistoma novo-ulmi* which is carried by the European Bark Beetle, *Scolytus multistriatus.*

The beetle bores into trees and the fungus it carries causes a vascular wilt. The fungus basically blocks the tree's vascular system (water transport) causing the branches to wilt and die, eventually killing the tree.

The national programme manged by the Ministry of Primary Industries (MPI) stopped funding the Dutch Elm Disease control programme in 2006-07. Subsequently staff at Auckland Council took on the coordinating role for the programme and sought assistance nationally from other councils to try and stop the spread of the disease.

The programme is still being funding by donations from councils and each summer a trapping and mapping survey is conducted to track the spread of the disease. There are many 10's of thousands of elm trees in the North Island on public and private land, and the loss of such a large amenity landscape tree has the potential to be devasting to local communities. There is a conservative estimate of over 16,000 elm trees in the auckland region and these are all threatened by the disease.

In Auckland Central one of the last remaining Elm trees outside the Auckland Art Gallery was found to be infected and was removed in 2019. It was one of the last of this species in the Central City planted on public land. There are likely to be Elm trees on land in both public and private ownership in the Devonport-Takapuna Local Board area that are vulnerable to the disease so it's important to ensure the public are aware of the need to report Elm trees that are looking sick or have areas of die back immediately.

Council and contract partners try wherever possible to help with the costs of removing trees that are positively identified as being infected. There have been a number of infected trees identified in the Devonport-Takapuna Local Board area over the years and the population of Elm trees is on the decline.

The fungal disease is now listed as an unwanted organism in the Regional Plant Pest Management Strategy. Council provides information and advice on the disease. Auckland Councils Forest Health Specialist helps with education and is currently conducting a trail control program.

A tree injection process developed in Europe, Dutch Trig® is a vaccination of a biocontrol that is very effective at giving Elm trees a level of protection from the disease, and Council is now adopting this technique to help protect the most valuable and vulnerable trees. In the first year of the injection programme just over 1000 Elm trees across auckland region were injected. In the second year an estimated 1500 trees will be inoculated.

In 2022 trees located in the Waikato were found to be infected with the disease and this is the first recorded case outside of the auckland region. It has now also been found in Te Awamutu and firewood is the suspected vector as the beetle is unable to travel this far. Auckland Council is working with Waikato Councils on steps to try and control the spread.

3.8.5 Summary

There are a range of potential pest and diseases that threaten the health and vitality of trees and groups of trees that make up the urban ngahere on public and private land.

Council works closely with government agencies on research and is one of the principal advocates for more funding allocation at a local government level to address pests and diseases that are impacting on amenity trees in our towns and cities across the country.

Tree health[9] is an important issue for all communities and it's important to raise awareness on the need to report sightings of unusual insects or signs of disease on a plant, shrub or tree in their garden or local park to their council or MPI. More details can be found at, www.mpi.govt.nz or a pest sighting can be reported through the disease hotline on 0800 80 99 66.

Figure 24 show the effects of Dutch Elm Disease in summer 2021. Figure 23 shows three variegated Elm trees. The healthy Elm is in the front left foreground of the picture and the two trees in centre right of the photo both have DED and have lost 90% of their foliage.

[9] https://www.mpi.govt.nz/biosecurity/exotic-pests-and-diseases-in-new-zealand/pests-and-diseases-under-response

Figure23: A healthy elm in top left foreground with an infected and well-advanced tree in centre of photo.

Figure24: Classic symptoms of DED, brown and wilting foliage, infected tree in photo taken mid-summer 2021

4.0 Recommendations and next steps

4.1 Recommendations

The recommended next steps are guided by the initial draft results obtained from the analysis work outlined in section 3.0. The work is based on analysis of data derived from the Aerial imagery analysis undertaken on imagery from 2017 and 2022 and the results of this work have been over laid with the LiDAR data analysis work from 2013-2018.

The two types of analysis help provide a more detailed finer grained picture of the changes and trends that are developing overtime with tree canopy cover across the local board area.

The current findings of the analysis work, indicates a decline in tree canopy coverage on privately owned land, alongside increases in tree canopy on public land. A percentage of the losses identified between 2017-2019 by the AI analysis work are taking place through land use changes occurring in urban infill development, infrastructure upgrades.

The gains are taking place with new plantings in 2017 that were not detected, now being sufficiently established to be detected in the 2022 imagery. Early finding is also indicating that trees retained over the time period of the analysis have grown and increased in size which is a positive finding of the study.

An increase in tree canopy coverage on public land including new tree plantings that may not have been picked up in the 2018 LiDAR data set are now potentially being recorded in the analysis of the 2022 imagery.

The analysis has identified a number of areas of grassland that sits in public ownership that could have trees planted in select locations to increase canopy cover without necessarily impacting on the primary land use of the area eg sport fields with opportunity to plant perimeter trees for shade of spectators or other park users.

The playground study in section 3.7.3 provides good data on playgrounds on public land that have low levels of natural shade. This data can be used to help inform the local board where opportunities exist to carry out new specimen tree planting.

Analysis of the data has provided a better understanding of the trends and status of the canopy cover in the Devonport-Takapuna Local Board area. This has helped identify key areas for greater protection of existing tree cover and where the most value can be realised from tree planting initiatives.

Several areas have lower tree coverage and the range in tree cover in the various statistical areas within the board area provides an indication on how the data can be used to help inform a plan of action to increase tree cover. As an example, focus could be placed on planting new trees in areas where there are greater population densities, in parks around playgrounds with no shade, in areas that are flood prone and where environmental values (e.g. water quality), aesthetic landscape and recreational values would be improved by plantings.

4.2 Next Steps

Some of the key points recommended for consideration in the development of the growing phase of the ngahere programme, particularly for public parks, are:

- to prioritise new plantings in existing reserves with little or no urban forest with locations determined through consultation with park users
- to ensure plantings allow for open green space to be retained in parks for recreational purposes
- to ensure tree plantings are designed to add value to a space, e.g. providing shade for play areas
- to focus initial opportunities for urban ngahere growth in locations where existing ngahere is in poor health and/or providing less than 30% coverage on public land
- to monitor the ongoing threats of amenity tree diseases and pathogens, such as Kauri Dieback and Myrtle Rust, as these diseases are expected to spread
- to work with the local community to plant a more diverse range of trees which will provide natural shade for current and future generations
- to regularly review the Auckland Urban Ngahere (Forest) Strategy and monitor whether the right trees are being planted in the right locations.

The above options are suggestions to help inform decisions on development of a longer-term plan to plant more trees where appropriate on public land in parks and along the roadside where space allows.

The primary recommendation is for the Devonport Takapuna Local Board to consider funding development of a 10-year Ngaere Action Plan.

The plan would aim to set out key areas of focus on public land to increase tree canopy cover. The plan would highlight the need to following a principle of the Ngahere Strategy to use of the right trees in the right place with community support to help grow the urban ngahere.

The action plan document could be used as a guidance framework to help inform future decision making around investment in tree planting in parks and streets across the local board area, alongside ensuring the trees planted increase benefits to residents and communities.

5.0 Acknowledgements

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- Dutch Elm Disease detail provided by Darryn Horrell, SPS Biota Ltd
- Early draft review completed by David Stejskal
- Photographs supplied by Auckland Council.
- Graphics and formatting completed by XX.

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