Tree Ledger

Urban Forest Intelligence.

InCanopy

About Us

About Us

You may know us from our earlier work as **Player Piano Data Analytics** — where we partnered with local governments across Australia to develop technology capable of identifying and tracking landscape features over time. Today, our focus is singular: **the urban forest**. We are now **InCanopy**.

At InCanopy, we collaborate with councils, planners, and environmental professionals to create tailored, data-driven solutions. Our work transforms complex geospatial data into meaningful insights that empower strategic decision-making and support innovative urban design.

We deliver quality. Technology is only as intelligent as the people behind it. Our team combines advanced AI and data science expertise with the precision of over 18 local Image Analysts who train, verify, and maintain the integrity of every dataset.

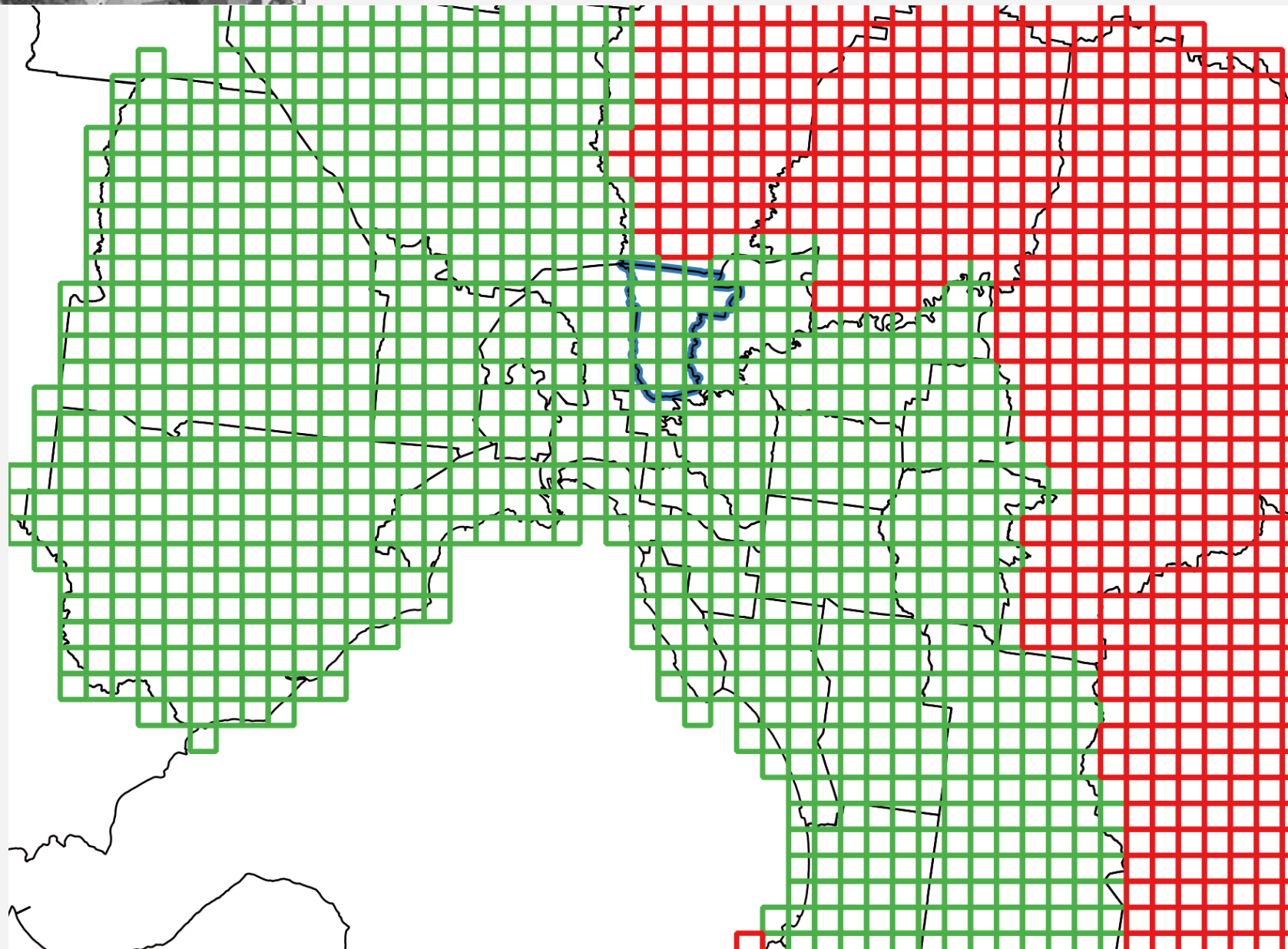
We are experienced. We have successfully delivered projects for numerous local governments and state agencies, providing accurate, scalable insights that support long-term urban forest management.

We believe in openness. Collaboration and transparency are core to our ethos. We promote open data and ensure our clients have unrestricted access to derived datasets for continued use and innovation.

Coverage

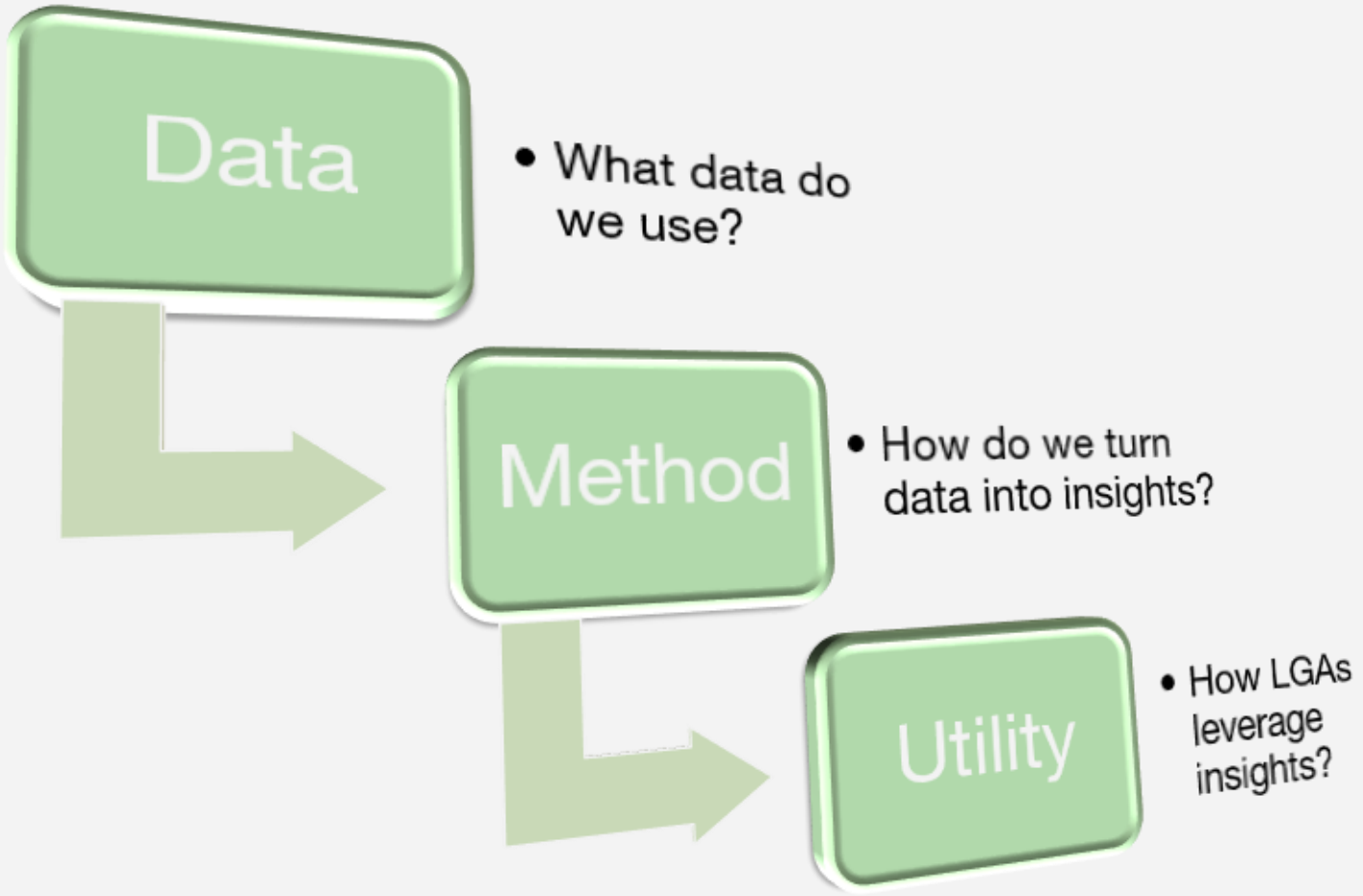
Tree Ledger Melbourne Extent

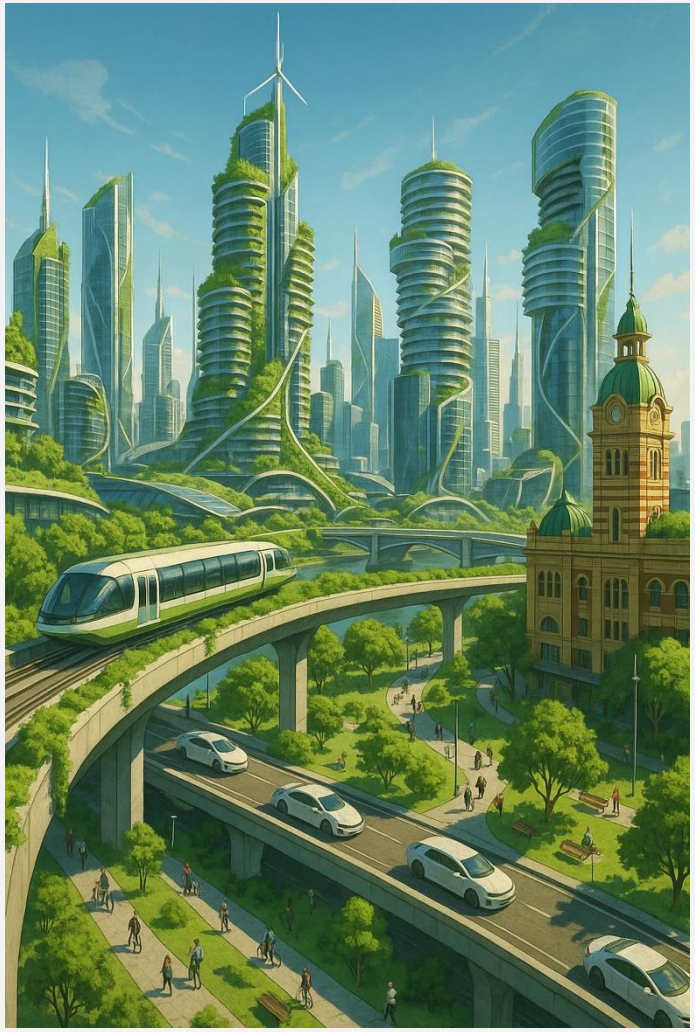
Green = Completed
Red = Completed by 02/2026



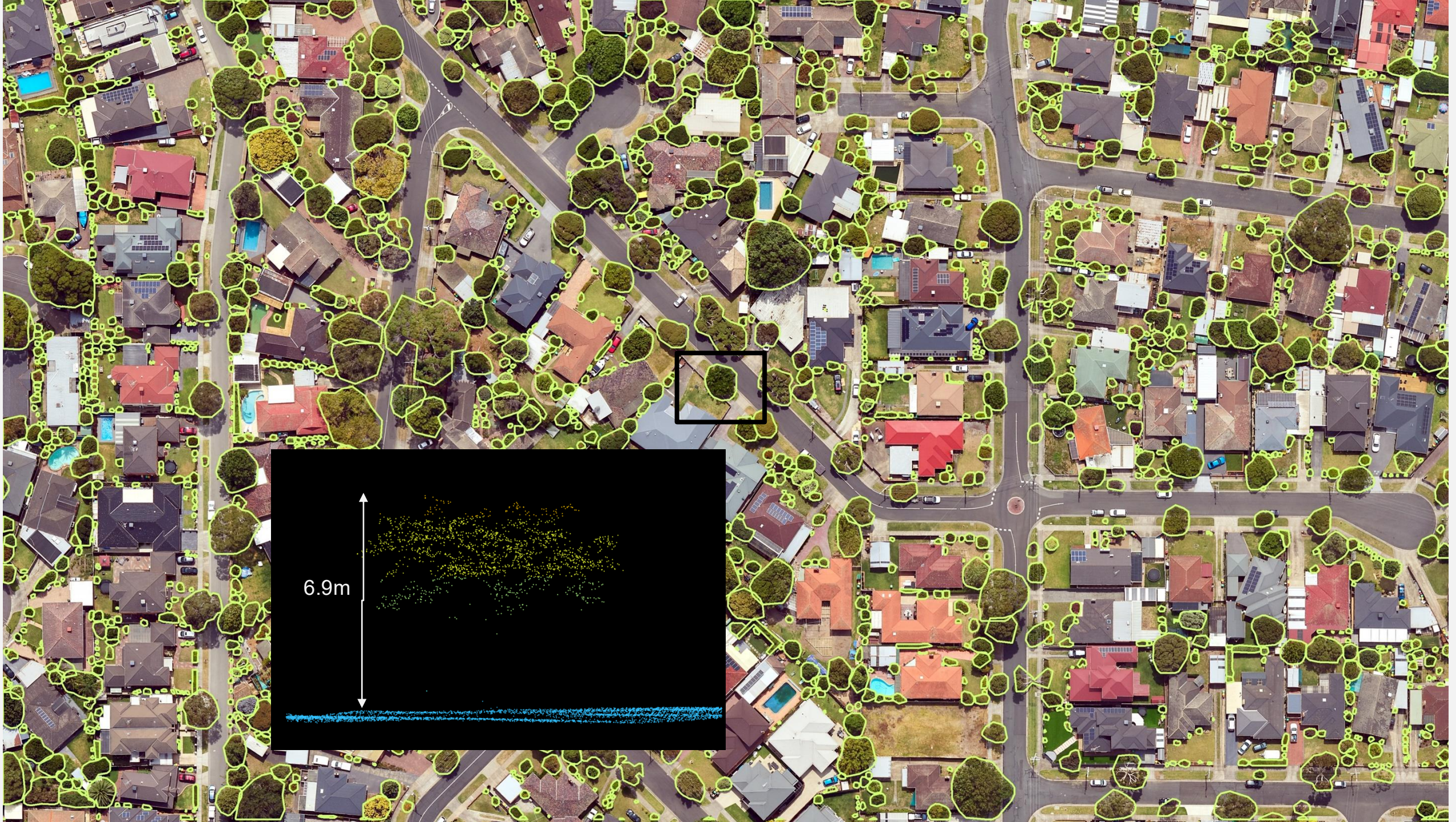
Service

Urban Forest Monitoring and Management Solution






68.1m²


6.9m


Total Vegetation 17,250.8m²
Total Area 90,000m²
Total Tree Cover/Total Area = 19.1% Cover

Classification

Foliage Gain is a 2D increase of canopy attributed to an individual tree or cluster of trees. These records are categorized as ‘gain’ when there is a year-on-year increase >1.5% of the preceding detected size.

Classification

Removals/Deaths represent the complete removal or death (no foliage) of a tree from a set year. In this case, this is vegetation that had been detected in the 2014 photography but is not present in any of the following years.

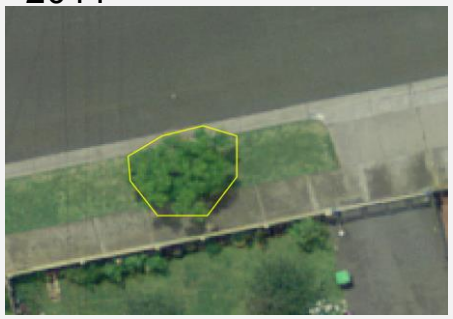
2014	2016	2018	2020
			
86.3m²	50.2m²	62.5m²	88.3m

Classification

New Plantings are complete new observations from a set year. In the case, this is vegetation that had not been detected in 2014 but is consistently present in at least 2 subsequent years.

Porous Surface Study

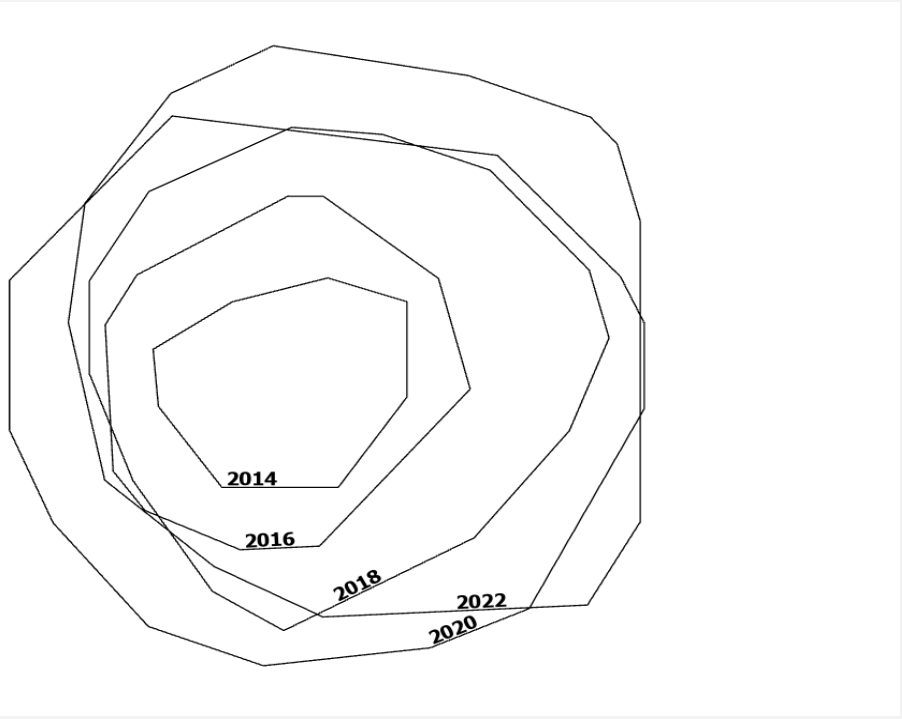
2014



2020

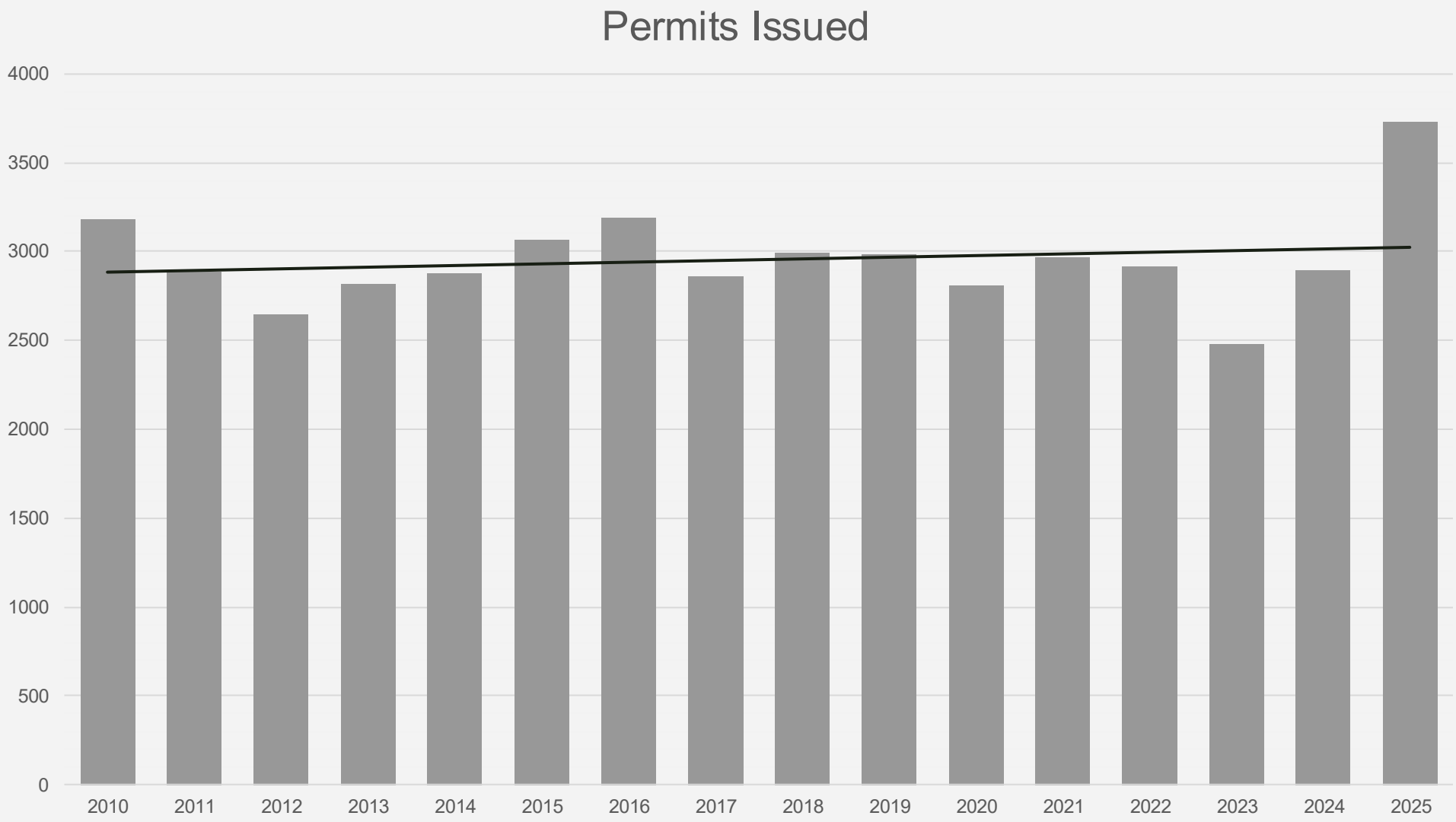
2016

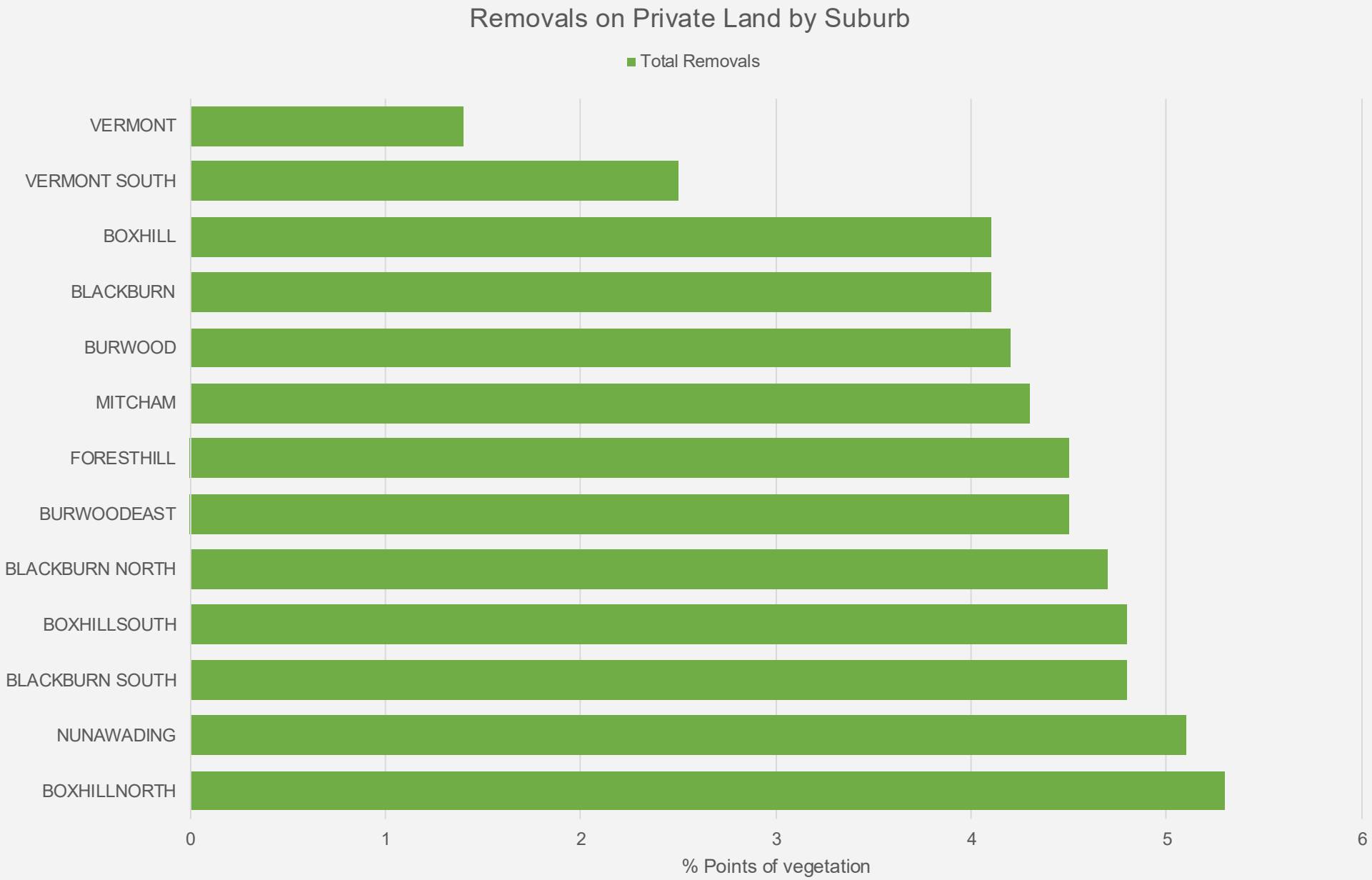
2022

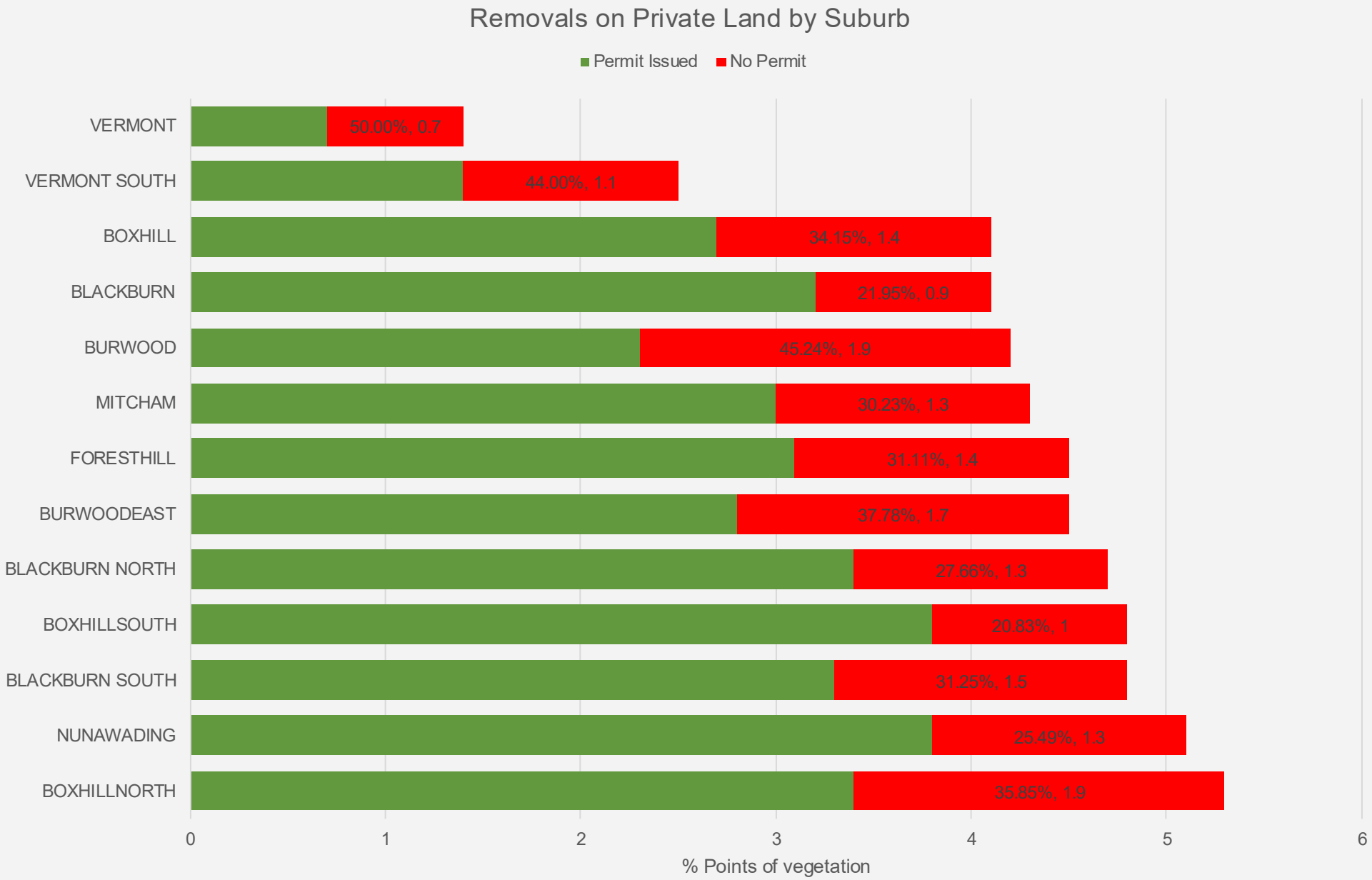


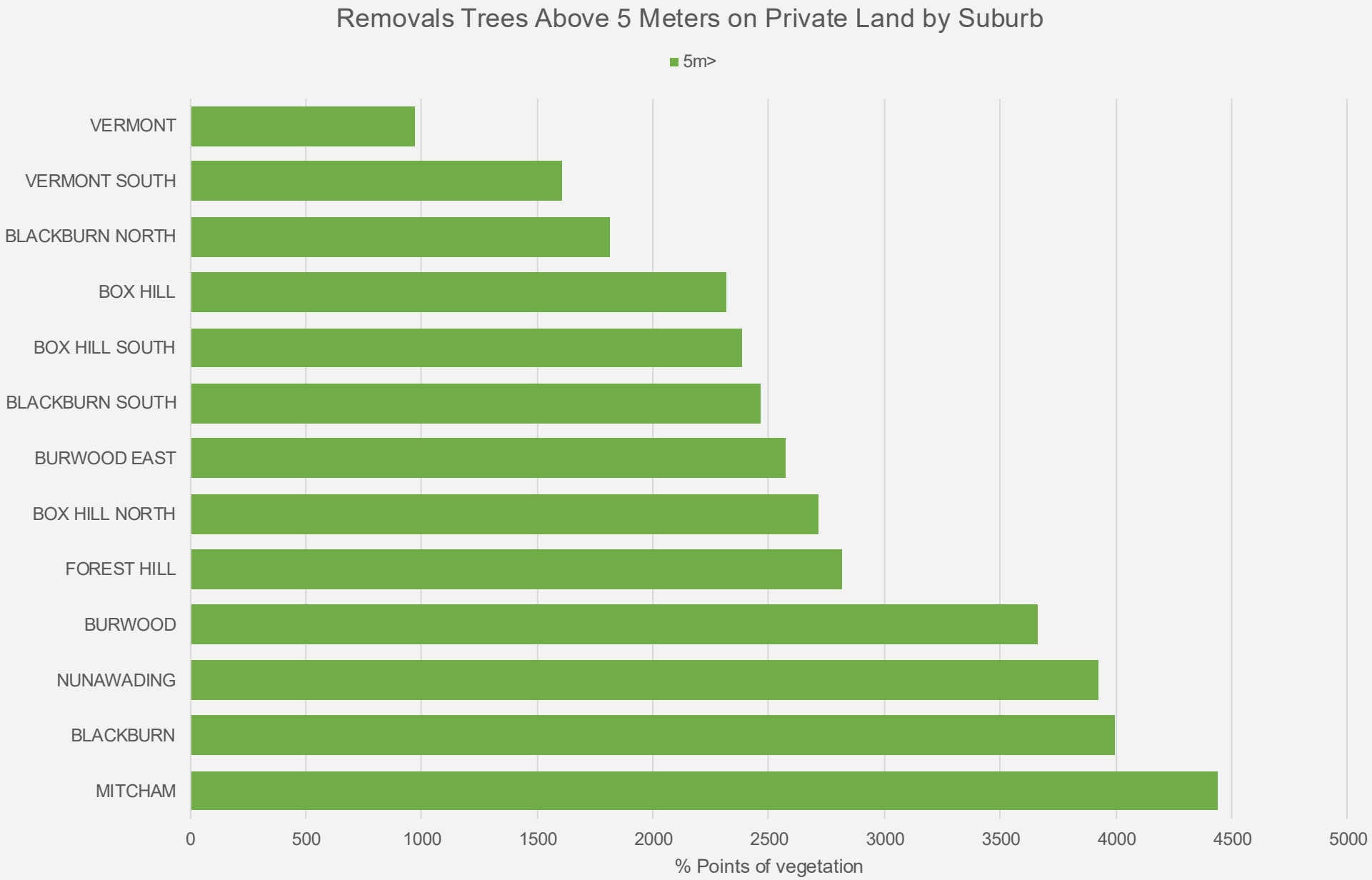
2018

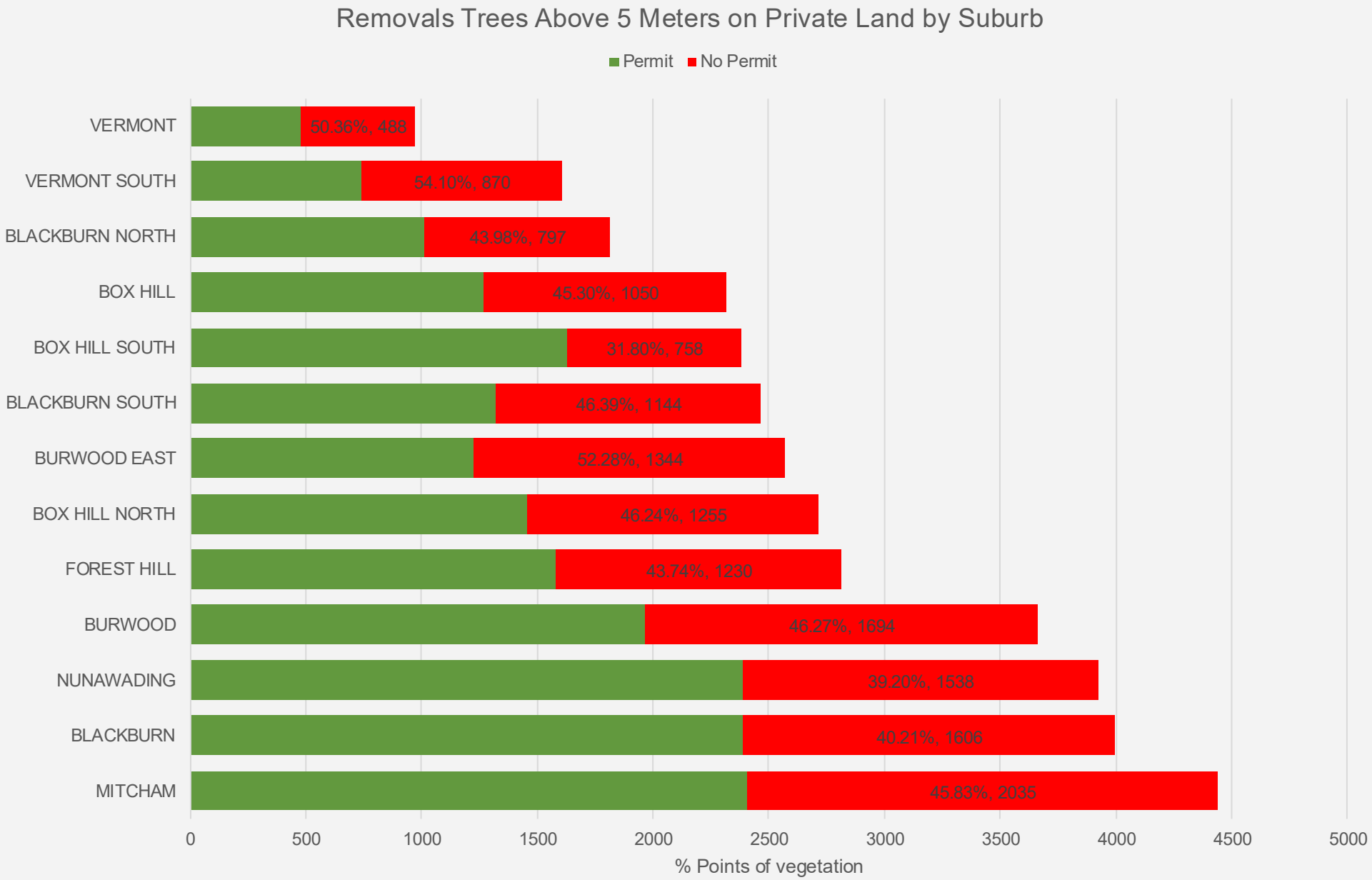
YEAR	Area (m²)	Height (m)	nDVI
2014	10.4	-	-
2016	23.7	-	-
2018	46.9	6.2	-
2020	68.6	-	0.19
2022	69.1	7.3	0.26


Permits Issued
4000
3500
3000
2500
2000
1500
1000
500
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Removals on Private Land by Suburb
Total Removals
VERMONT
VERMONT SOUTH
BOXHILL
BLACKBURN
BURWOOD
MITCHAM
FORESTHILL
BURWOODEAST
BLACKBURN NORTH
BOXHILLSOUTH
BLACKBURN SOUTH
NUNAWADING
BOXHILLNORTH
0
1
2
3
4
5
6
% Points of vegetation


Removals on Private Land by Suburb
Permit Issued
No Permit
VERMONT
VERMONT SOUTH
BOXHILL
BLACKBURN
BURWOOD
MITCHAM
FORESTHILL
BURWOODEAST
BLACKBURN NORTH
BOXHILLSOUTH
BLACKBURN SOUTH
NUNAWADING
BOXHILLNORTH
50.00%, 0.7
44.00%, 1.1
34.15%, 1.4
21.95%, 0.9
45.24%, 1.9
30.23%, 1.3
31.11%, 1.4
37.78%, 1.7
27.66%, 1.3
20.83%, 1
31.25%, 1.5
25.49%, 1.3
35.85%, 1.9
0
1
2
3
4
5
6
% Points of vegetation


Removals Trees Above 5 Meters on Private Land by Suburb
5m>
VERMONT
VERMONT SOUTH
BLACKBURN NORTH
BOX HILL
BOX HILL SOUTH
BLACKBURN SOUTH
BURWOOD EAST
BOX HILL NORTH
FOREST HILL
BURWOOD
NUNAWADING
BLACKBURN
MITCHAM
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
% Points of vegetation

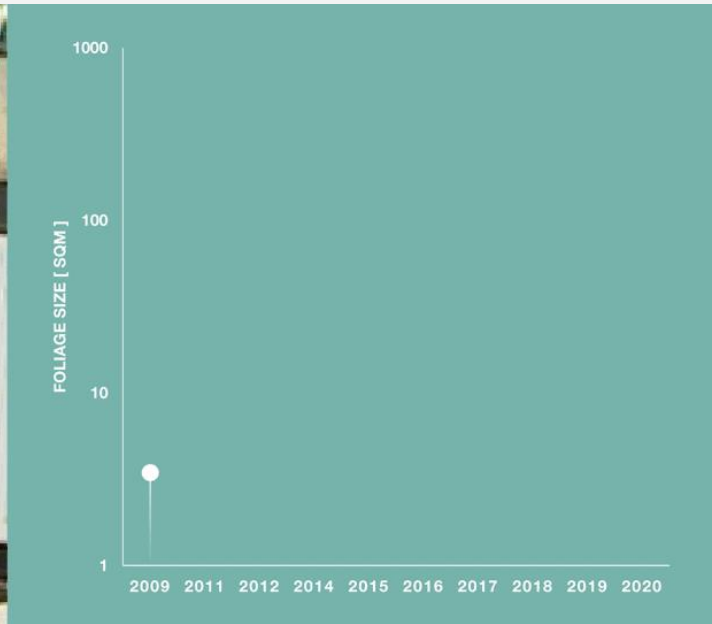

Removals Trees Above 5 Meters on Private Land by Suburb
Permit
No Permit
VERMONT
VERMONT SOUTH
BLACKBURN NORTH
BOX HILL
BOX HILL SOUTH
BLACKBURN SOUTH
BURWOOD EAST
BOX HILL NORTH
FOREST HILL
BURWOOD
NUNAWADING
BLACKBURN
MITCHAM
50.36%, 488
54.10%, 870
43.98%, 797
45.30%, 1050
31.80%, 758
46.39%, 1144
52.28%, 1344
46.24%, 1255
43.74%, 1230
46.27%, 1694
39.20%, 1538
40.21%, 1606
45.83%, 2035
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
% Points of vegetation

Tree Ledger

Tree Ledger extracts information from aerial photography and LiDAR surveys to create a council-wide GIS database of observations of individual trees over time.

The database represents tree foliage as 2D polygons, with a georeferenced X,Y location for each individual tree. In addition, our LiDAR integration algorithms have been developed to iteratively delineate individual trees within dense clusters. At its core, Tree Ledger is built on the latest advances in deep learning algorithms and human-derived ground truth to ensure that the highest of accuracy can been achieved.

- It builds a narrative around the presence and rate of change occurring at any individual tree.
- It has multiple applications and is used to track and forecast council wide canopy targets, along with monitoring trees at an individual scale.



Web Map Tool

LEAF Webmap Tool

Included in Tree Ledger is 24 months' hosting and access to our browser based Live Explorer Analytics Finder [treeledger.com.au].

Clients will have multi-user access to allow for user friendly, on-demand custom reporting from their Tree Ledger database.

On Demand Reports

On Demand Reports

Our data visualisation reports give you a digestible overview of the condition and changes of urban canopy in your areas of interest. Our reports classify canopy change through four key factors to help you understand the causes of canopy change :

• Growth — when a tree is naturally increasing in size.

• Planting — when a tree appears for the first time.

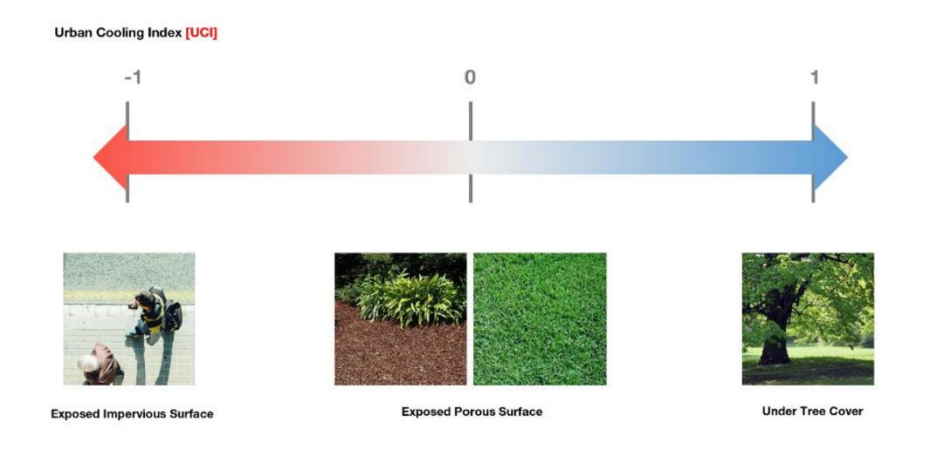
• Decrease — when a tree is decreasing in size due to pruning, senescing, or disease.

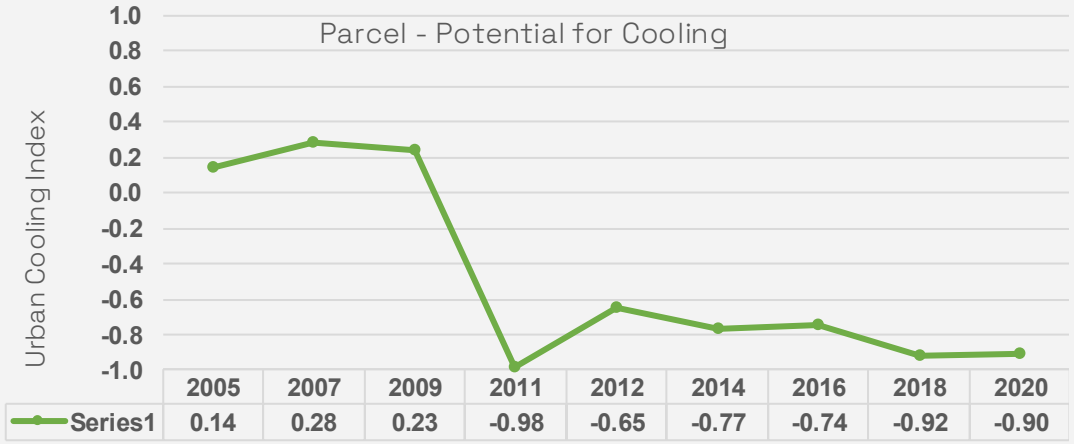
• Removal — when a tree disappears completely due to felling or storm damage

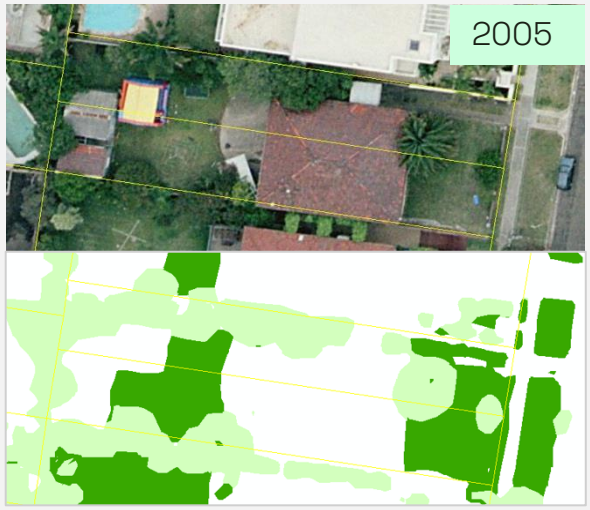
Urban Cooling Index

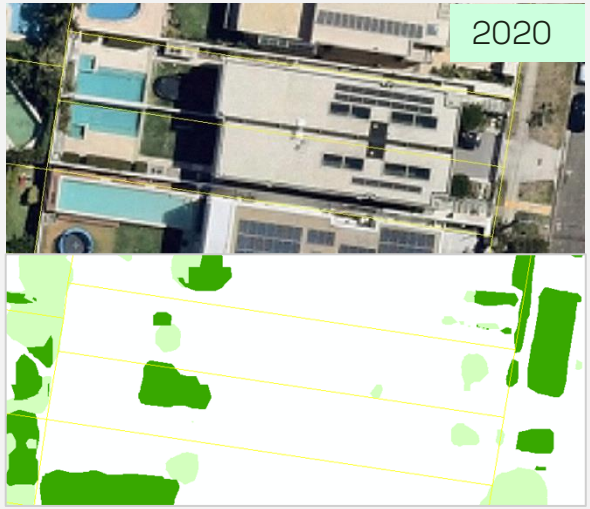
Urban Cooling Index (UCI) is a value between -1 and +1 that is assigned to every residential plot each year in the study period.

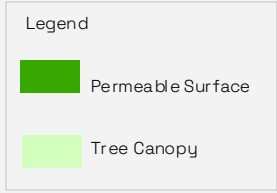
The chart below shows a sample parcel and its corresponding UCI over time as it experiences subdivision and redevelopment.









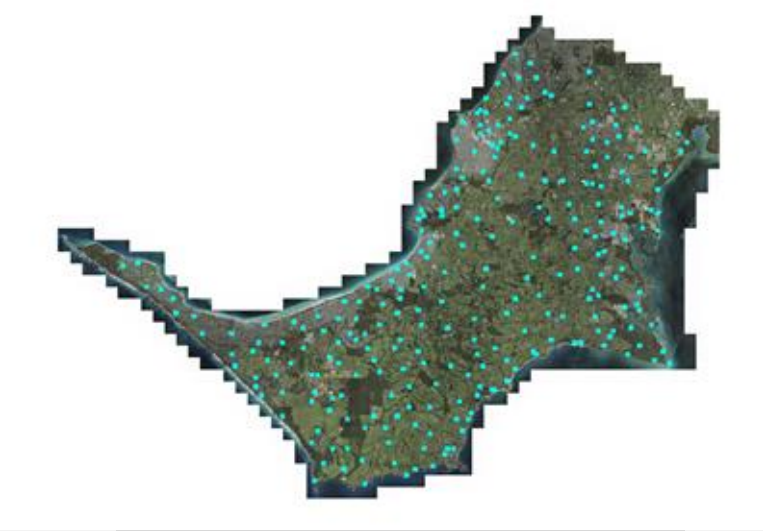


Training

The quality of any AI is only as good as the data used to build it. For every project, our Image Analysts create a custom and comprehensive machine learning training dataset that encompasses the diversity of the ecology and urban typologies found in the case study area. This ensures the highest accuracy in the final AI outputs as the algorithm is trained to identify canopy specific to the LGA.

1.2 Million

Manually Annotated Samples



Above: Training data sampled over the 723 sqkm case study area

Above: Sampled data encapsulate the diversity of the land use types and ecology

Above: Tile of completed training data generated by our Image Analysts

Specifications

Tree Ledger typically captures trees and their canopy – the process will be customized for this project to capture all green cover and porous surface.

Trees – For the purposes of this project “trees” are defined as woody plants comprising typically of a single trunk with a canopy and potential mature height greater than 3 metres.

Included in capture

- Trees (>3m)
- Bushes and shrubs of significant height (>3m)
- Hedges of significant height (>3m) to be captured as one entity where individual plants are not discernible to the human eye
- Grasses and lawn
- Rooftop Gardens

Excluded from capture

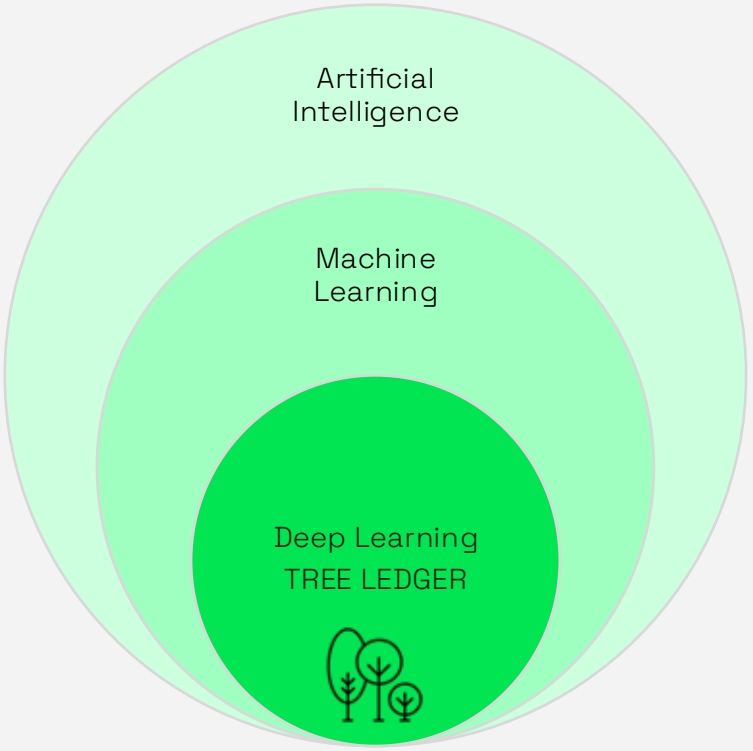
- Groundcover
- Aquatic plants
- Potted plants
- Dead trees (if quality of photography allows)

Machine Learning

Machine learning is a subset within the field of artificial intelligence. It uses algorithms and mathematical models to analyse and draw inferences from patterns in data.

Deep learning is a further subset of machine learning where the pattern recognition capacity of the mathematical models is exponentially multiplied through the application of artificial neural networks, with linear equations numbering in the hundreds of millions. Tree Ledger uses supervised deep learning to segment pixels in the photography and further machine learning to connect tree observations over multiple photographs.

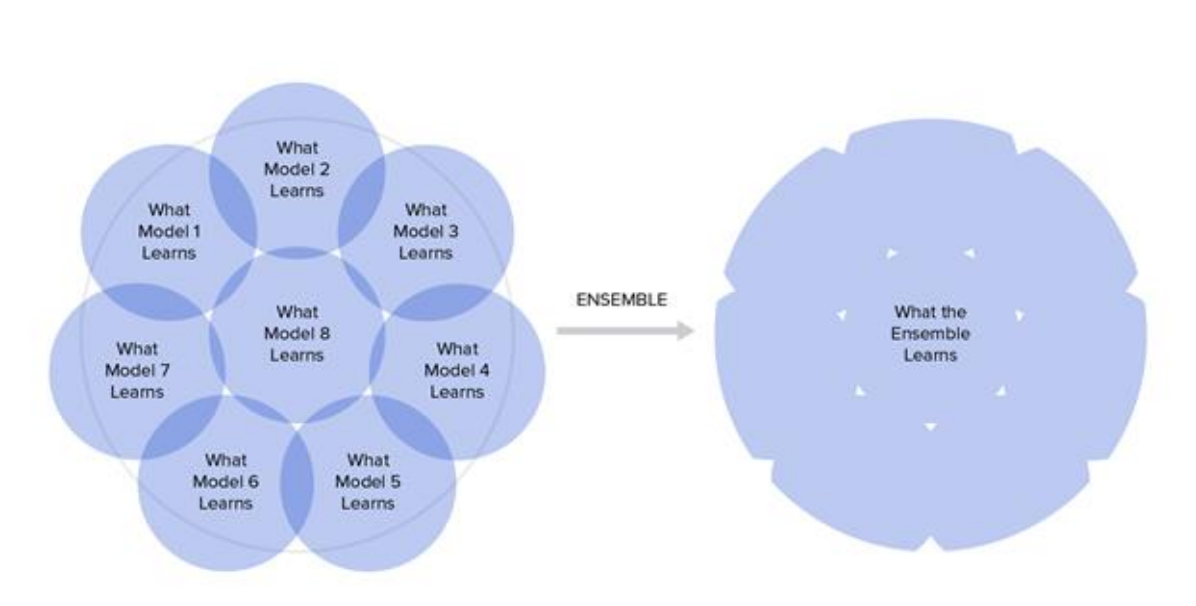
The main draw card of using machine learning is that tasks (such as recognising objects of interest within photography) can be automated by a computer and present significant time and cost savings when compared to manual processes.



Feature Extraction

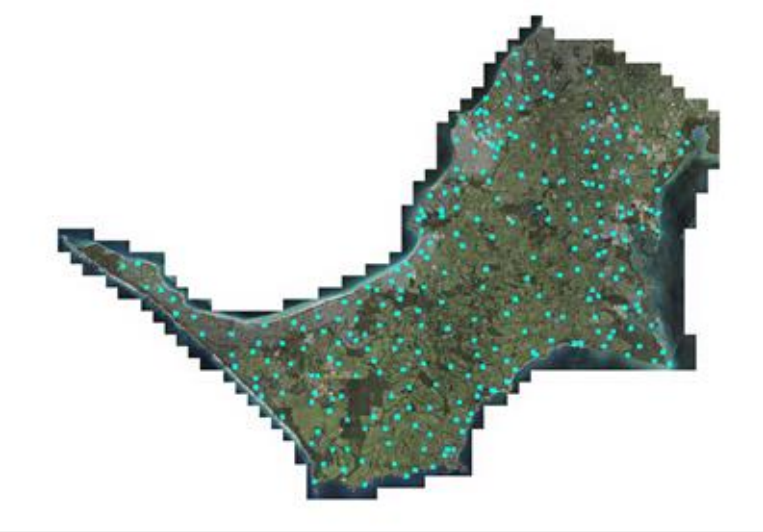
A highly accurate human derived training dataset will enable us to train multiple deep learning models, from which we will select and combine the best performing qualities of each. This is called an ensemble model.

In our experience, to achieve a reliable level of AI accuracy with minimal human intervention, around 5-7% of the total area needs to be covered by human derived training data. With this method we are able to build an ensemble AI advanced enough to confidently extrapolate what it has learnt to the remaining 93%-95% of the case study area.



Training Data

The quality of any AI is only as good as the data used to build it. For every project, our Image Analysts create a custom and comprehensive machine learning training dataset that encompasses the diversity of the ecology and urban typologies found in the case study area. This ensures the highest accuracy in the final AI outputs as the algorithm is trained to identify canopy specific to the LGA.



Above: Training data sampled over the 723 sqkm case study area

Above: Sampled data encapsulate the diversity of the land use types and ecology

Above: Tile of completed training data generated by our Image Analysts

Quality Assurance

Below: Example of quality assurance instructions distributed to Image Analysts

Once the final ensemble model has been extrapolated across all supplied photographs, the AI outputs of one photograph is distributed to the Image Analysts to quality assure for accuracy and consistency.

The case study area is parcelled into 250m x 250m tiles with the algorithmically detected trees overlaid onto the corresponding aerial photograph. By establishing a 'point of truth' layer in the dataset through human validation/correction, we gain a higher level of confidence in the overall dataset.

Quality assurance instructions specific to the case study area is distributed to the analysts outlining high and low priority tasks, along with examples of common errors to look out for.

Deliverables

Tree Ledger

Machine derived tree observations over the nominated study period.

Observation Database [.gdb/.shp/.tab]

> Polygonal representation of individual tree canopy over the study period. Tree ID links observations pertaining to an individual tree.
> Attribution to include:
> - Canopy geometry
> - Height of the canopy
> - Observation year
> - Land use and zoning information

Tree Ledger has been designed as a relational GIS database, to track change and individualised growth rates over time.

Project Report

Project report documenting the accuracy assessment and methodology.

Data Insights

A package of custom graphs and/or maps generated from Tree Ledger. This typically includes aggregated graphs and suburb specific analysis. It can also include maps showing Tree Cover Change (by year), Tree Losses (by year), We work with each client in customising the data analysis required to ensure the information delivered targets Council's strategic goals.

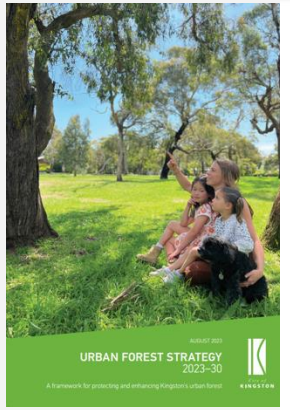
Outcomes

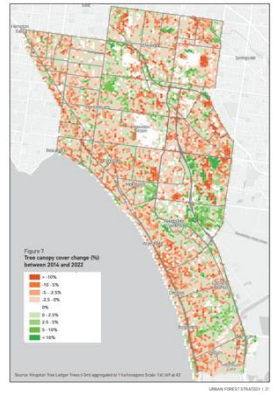
Tree Ledger Deployment

We have worked with the following LGAs to deliver Tree Ledgers and analysis customised to their strategic goals.

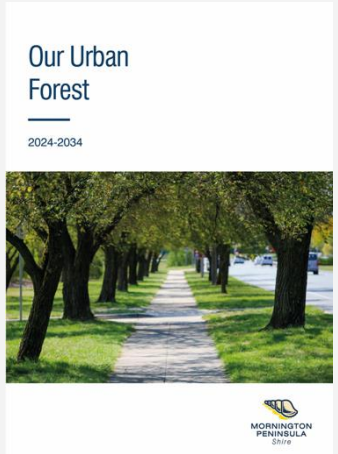
Council	Years
Melbourne City Council	2002-2023
Bayside City Council	2015-2019
City of Greater Bendigo	2012-2022
Maroondah City Council	2016-2024
Merri-bek City Council	2009-2022
Waverley Council	2005-2020
Frankston City Council	2017-2023
Mornington Peninsula Shire	2005-2024
Monash City Council	2012-2022
Port Phillip City Council	2012-2022

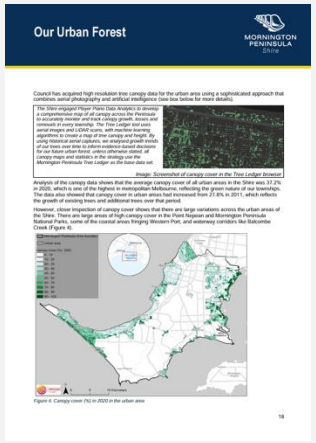
[Port Philip Urban Forest Strategy]



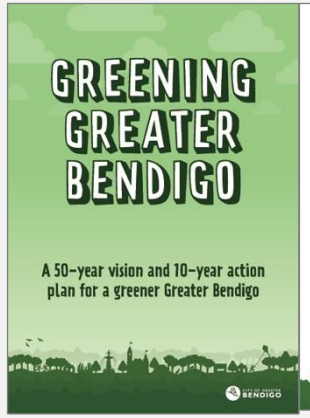


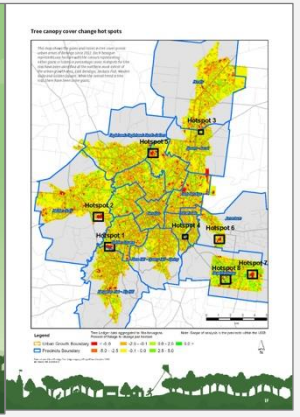
[Kingston Urban Forest Strategy]





[Mornington Peninsula Urban Forest Strategy]





[Greening Greater Bendigo 2020-2070]

Collaborations

Government bodies

Bayside City Council

Victoria State Government – Environment, Land, Water and Planning

City of Greater Bendigo

Mornington Peninsula Shire

City of Kingston

Maroondah City Council

Manningham – Balance of City and Country

Frankston City

City of Melbourne

City of Monash

City of Port Phillip

Waverley Council

Business Partnerships

Urban Forest Consulting

iteratec

Greener Infrastructure Consulting

E: lab@ppdataanalytics.com
W: https://ppdataanalytics.com

InCanopy