Town of Bassendean Aerial Vegetation Mapping

Tree Canopy Analysis

Urban Heat Island Mapping

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About Astron

- Astron is WA's largest and oldest independently owned environmental consultancy

- Astron's Geospatial team comprises PhD qualified remote sensing and GIS professionals with significant academic and industry experience

Introduction

- The Town is seeking to implement an Urban Forest Strategy
  - Requires ongoing monitoring that needs accurate and repeatable measurements of vegetation cover and health
  - Remote sensing techniques provide this, are affordable and well supported in the literature
- Astron's scope of works was to:
  - **Measure** the overall baseline **vegetation cover** of the Town's existing vegetation, including **height stratification**.
  - Determine the **condition of the vegetation**, using a commonly used/proven method, such as the normalised difference vegetation index (NDVI) algorithm.
  - Using the **Landsat thermal imagery**, provide Town-wide **mapping of heat islands** and analysis of heat island impacts.
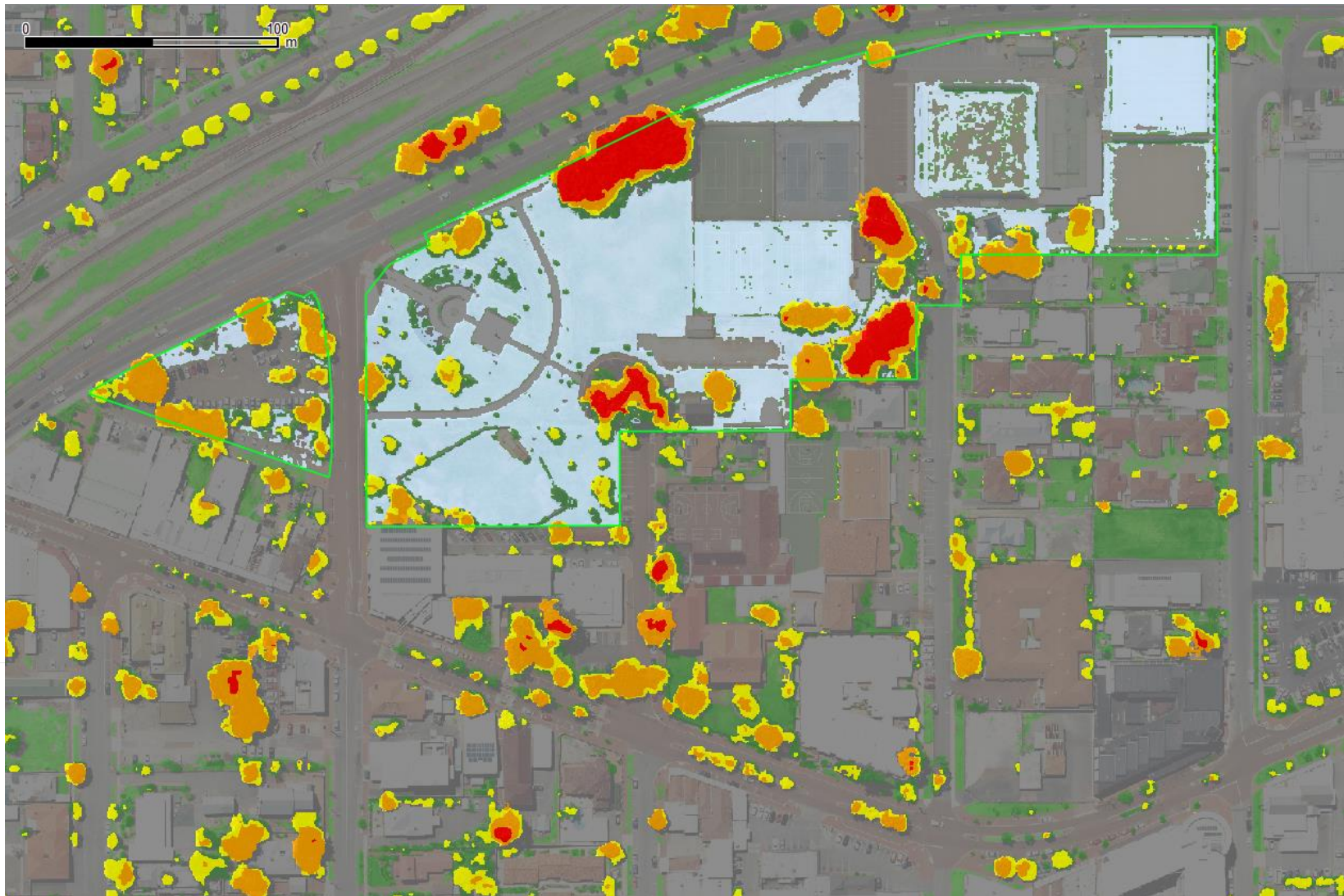
Methods – Data Sources

- Aerial survey data from Landgate
  - Captured February 2016
  - 15 cm resolution
  - Four spectral bands (RGB-NIR)
- Thermal imagery from Landsat-8 satellite
  - Captured 8 February 2016. 42.6°C at Perth Airport
  - 100 m resolution
- Vector data from the Town

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Methods – Vegetation Cover and Height

- In-house processing of raw aerial imagery provides a 3D model of the Town

- Machine learning algorithms and NIR data allow vegetation (including dry turf) to be separated from non-vegetation

- Combining these allows vegetation height to be stratified. The following classes were specified:
  - Non-vegetation
  - 0-2 m
  - 2-6 m
  - 6-15 m
  - >15 m
  - Turf (only for Parks and Reserves)

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Strata Key

⬛	Nonveg
🟩	0 - 2 m
🟨	2 - 6 m
🟧	6 - 15 m
🟥	> 15 m
⬜	Turf

Methods – Vegetation Health

- Modified Soil Adjusted Vegetation Index (mSAVI) chosen

- mSAVI performs better than NDVI for sparse vegetation over variable surface colours, and compensates for shadows

- Unit-less index scaled from -1 to 1

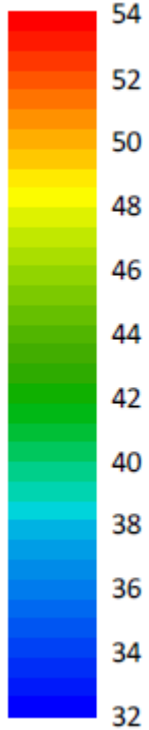- Vegetation present from 0.2 to 1 (nominally)

Methods – Vegetation Health

mSAVI
Scale

Low

High

- LST is kinetic temperature of the surface of the earth

- Differs from near-surface air temperature which is the kinetic energy of the air molecules

- LST contributes to air temp by passing energy through conduction and convection

- Some surfaces show a very low LST, but may be much hotter because they have very low thermal emissivity which is difficult to correct for
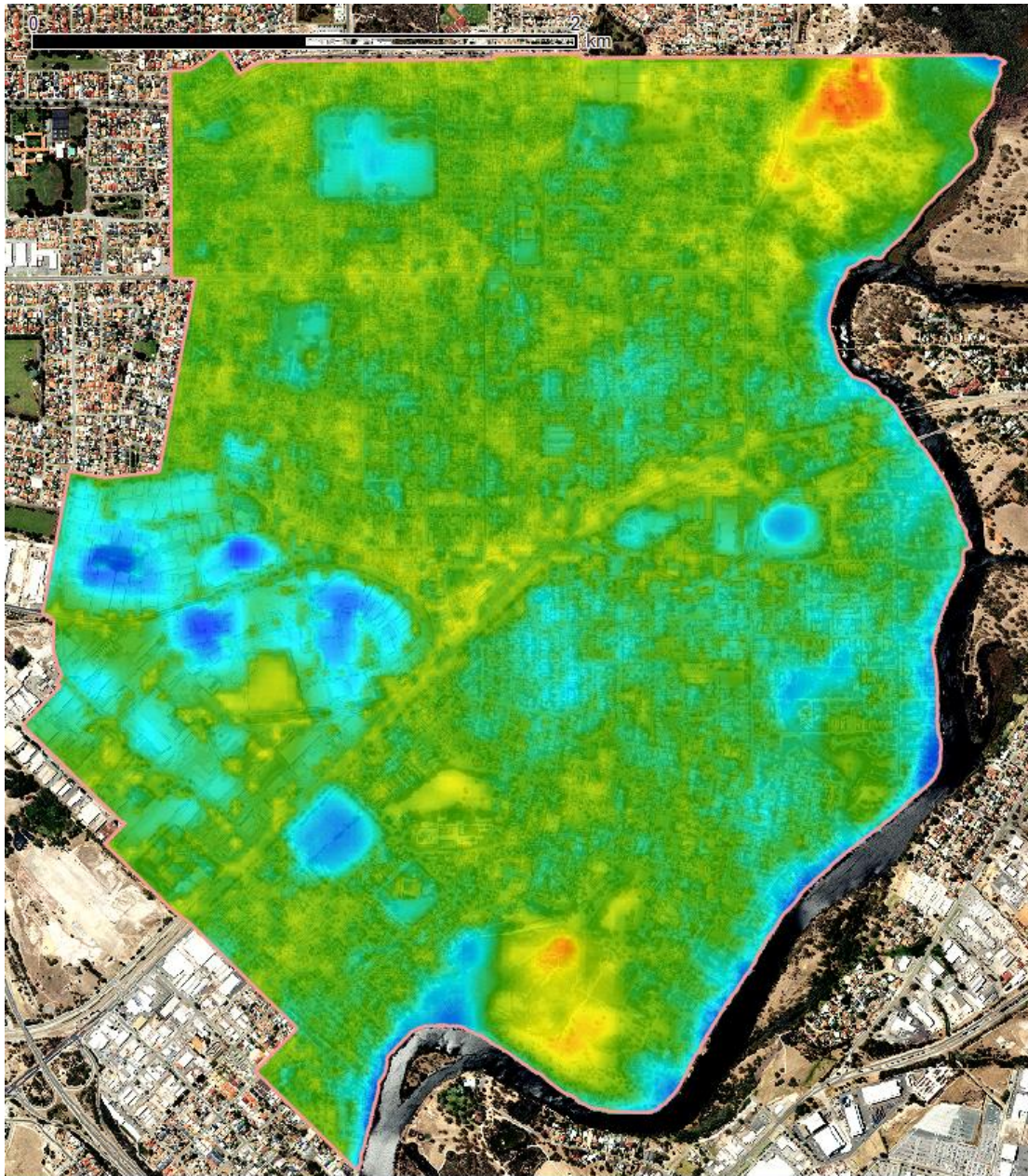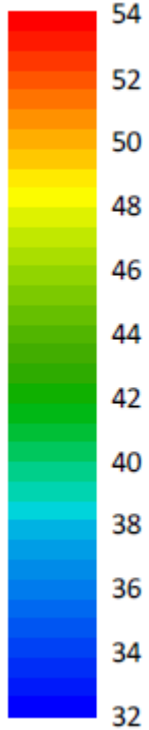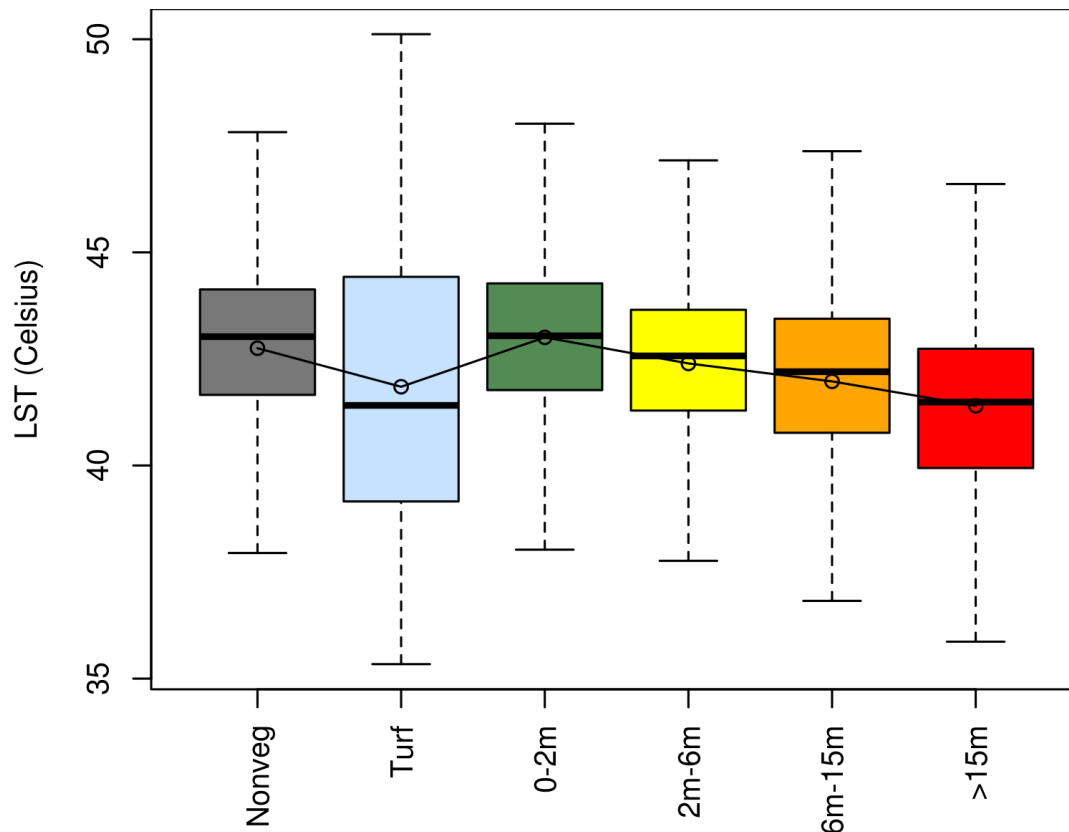
Methods – Land Surface Temperature
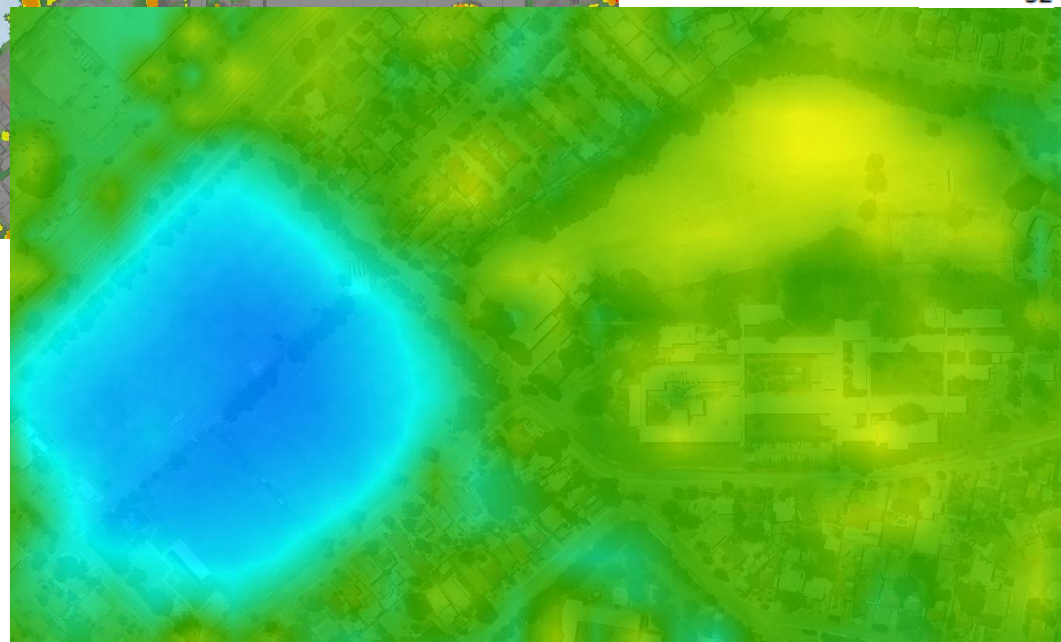
LST Scale
(° C)

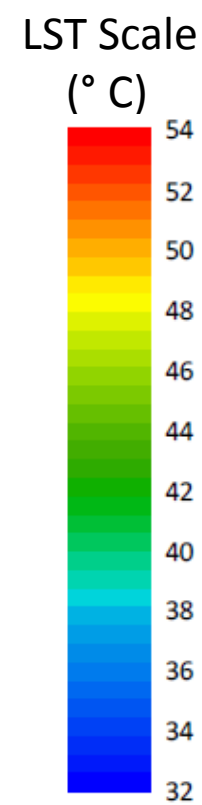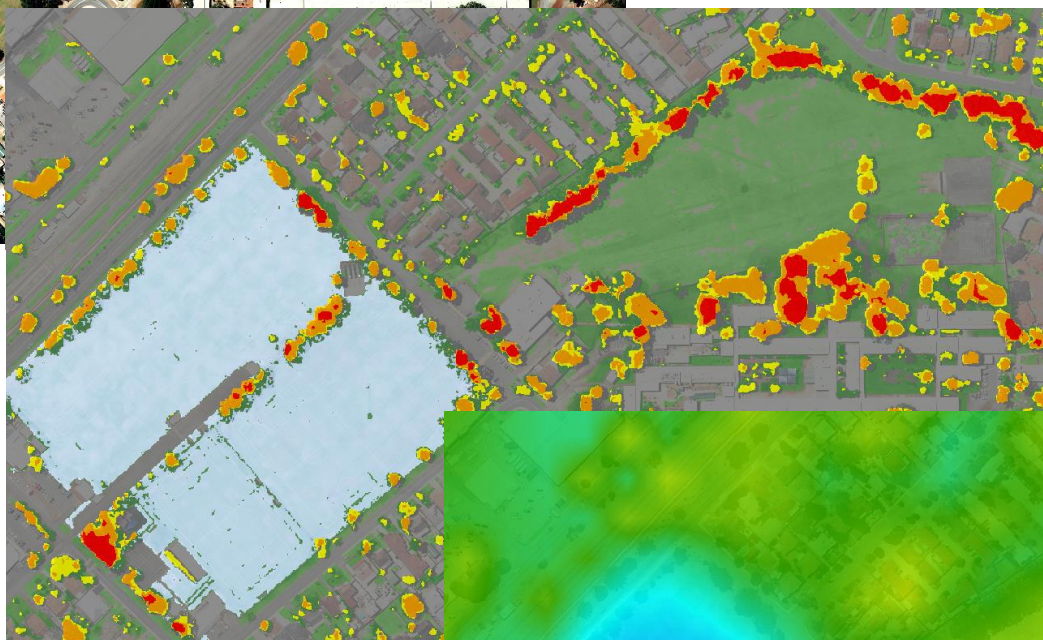- As the height of vegetation increases, local LST decreases
- This relationship is statistically significant
- The mean difference between 0-2 m and >15 m is 1.6°C
- Slight difference between non-veg and 0-2m
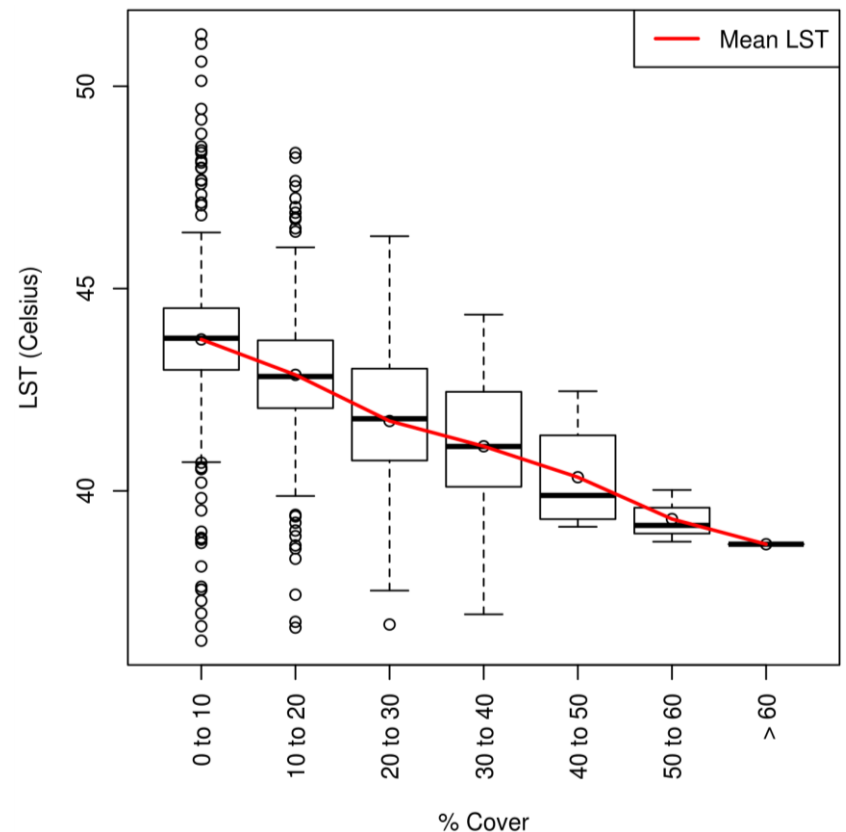- Large variation in Turf
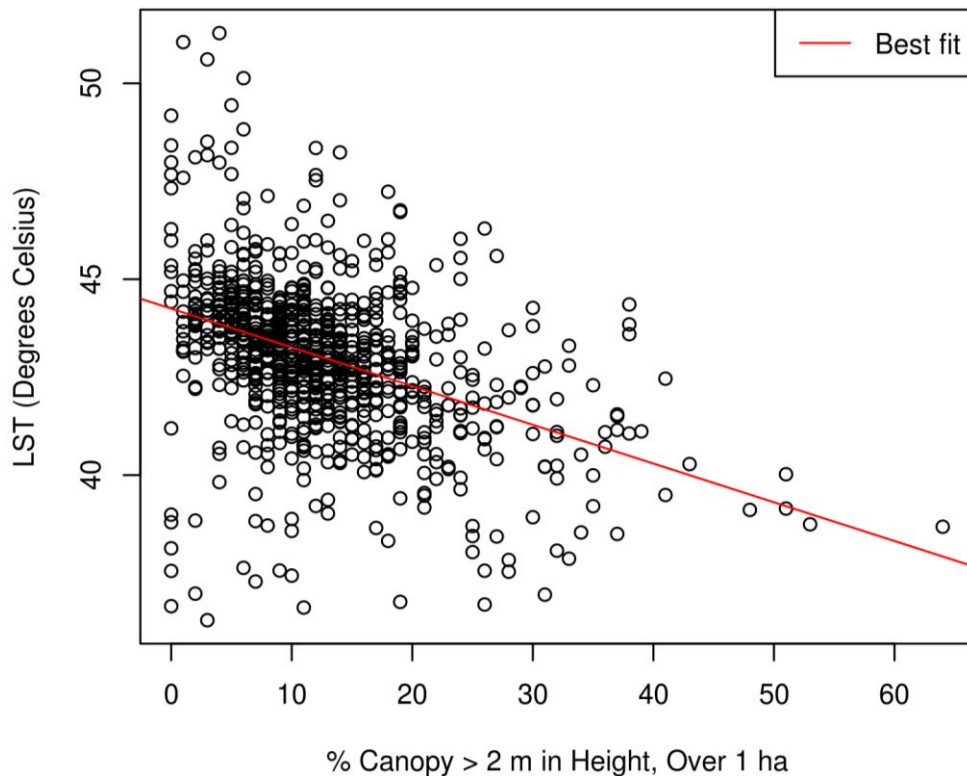
LST Scale (° C)

54
52
50
48
46
44
42
40
38
36
34
32

Strata Key

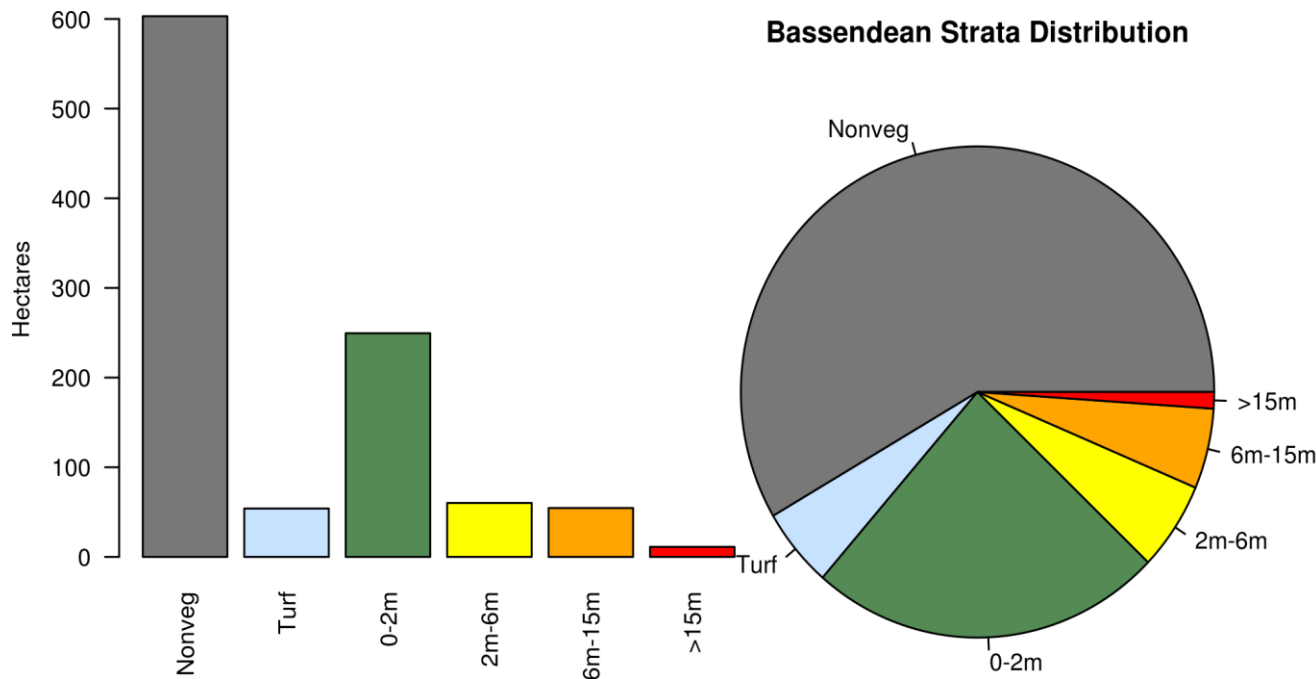|	
⬛ (gray)	Nonveg
🟩 (dark green)	0 - 2 m
🟨 (yellow)	2 - 6 m
🟧 (orange)	6 - 15 m
🟥 (red)	> 15 m
⬜ (light blue)	Turf

Results – Green Fraction and LST

- As green fraction (% cover) of vegetation increases, LST decreases

- Statistically significant only for lower cover classes (0-30%), due to paucity of data
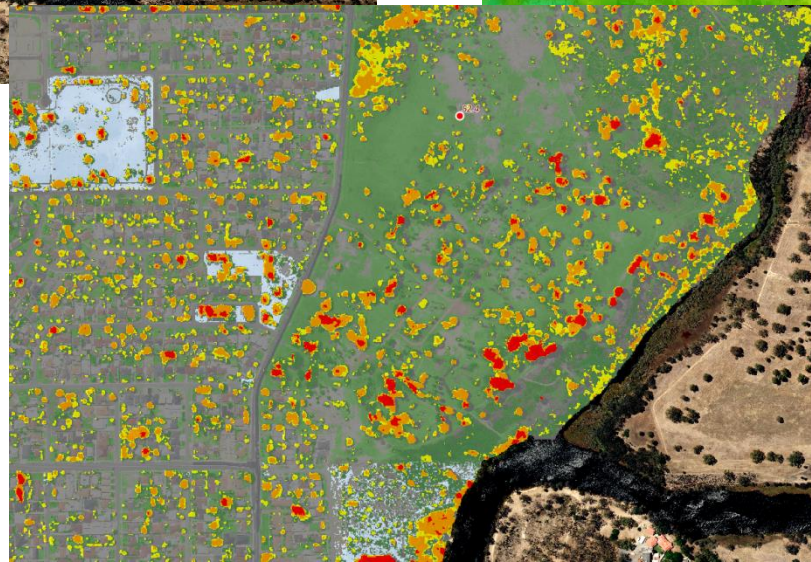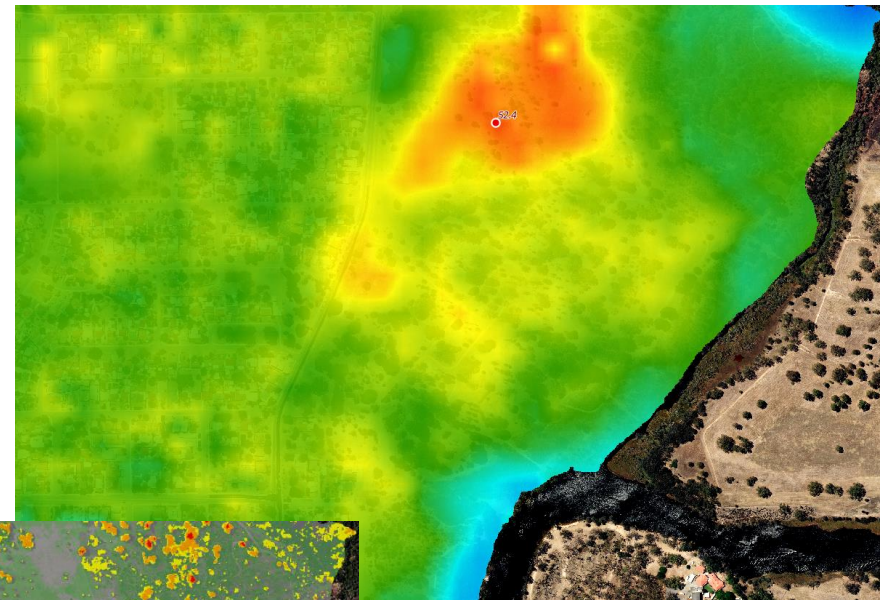
Results – Vegetation Height

- 42% of the Town covered by vegetation (429 ha)

- Majority in 0-2 m (24%) and turf classes (5%)

- 2-6 m, 6-15m and >15 m sum to 12%

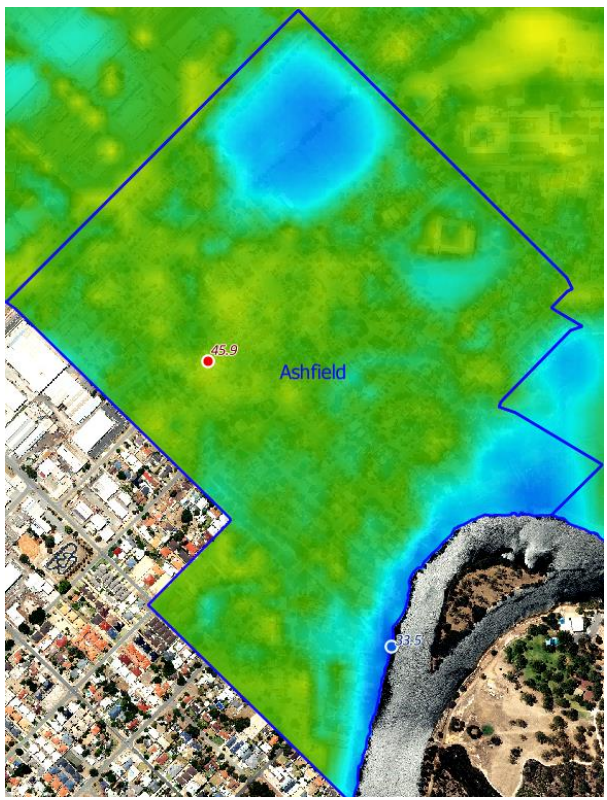| Stratum	Ha	Perc
Nonveg	603.05	58.41
Turf	54.00	5.23
0-2m	249.48	24.16
2m-6m	60.16	5.83
6m-15m	54.51	5.28
>15m	11.22	1.09

Results – Vegetation Height
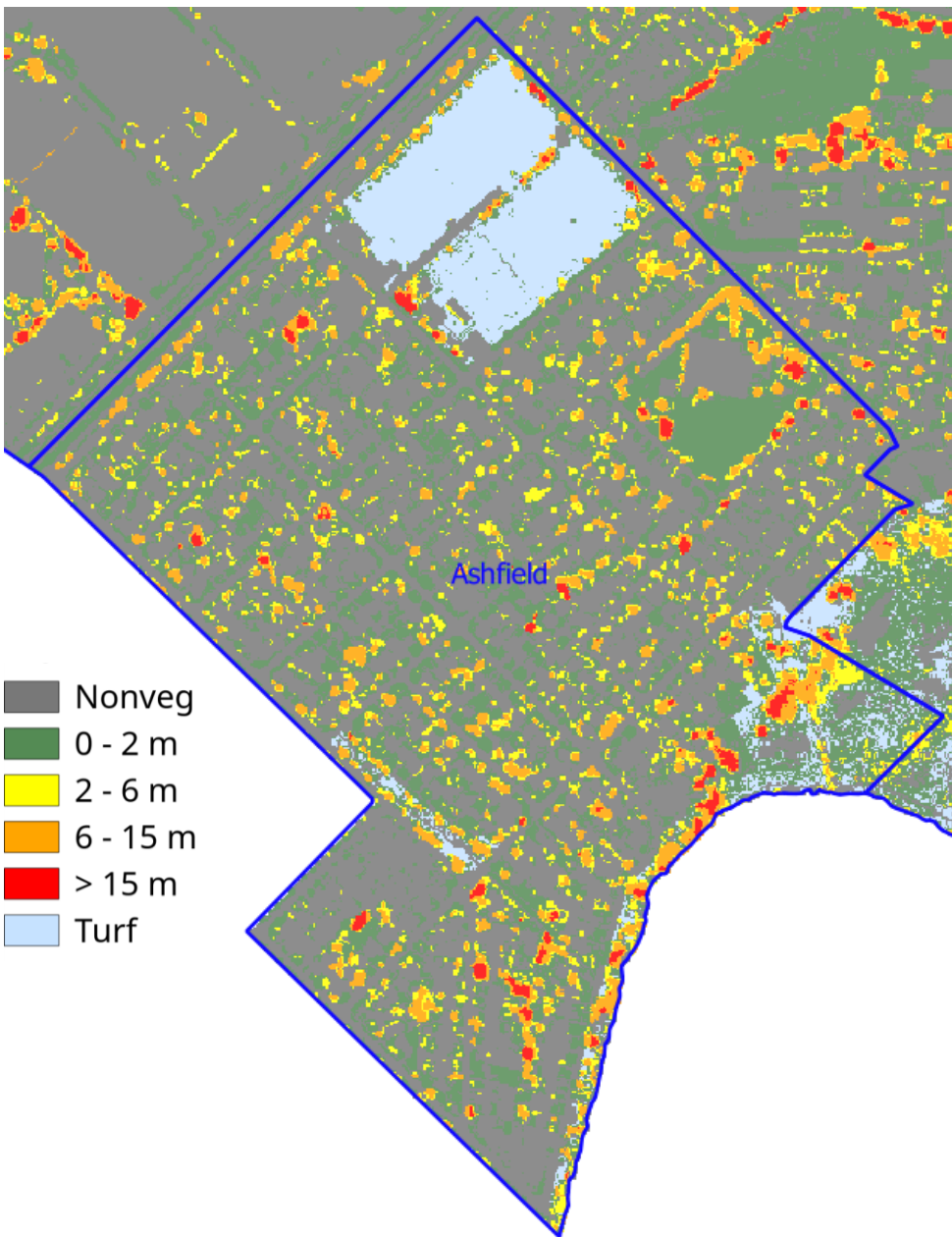
With 0-2 m not contributing to reducing LST the location of hottest area in the Town is counterintuitive…

Results – Vegetation Height - Ashfield
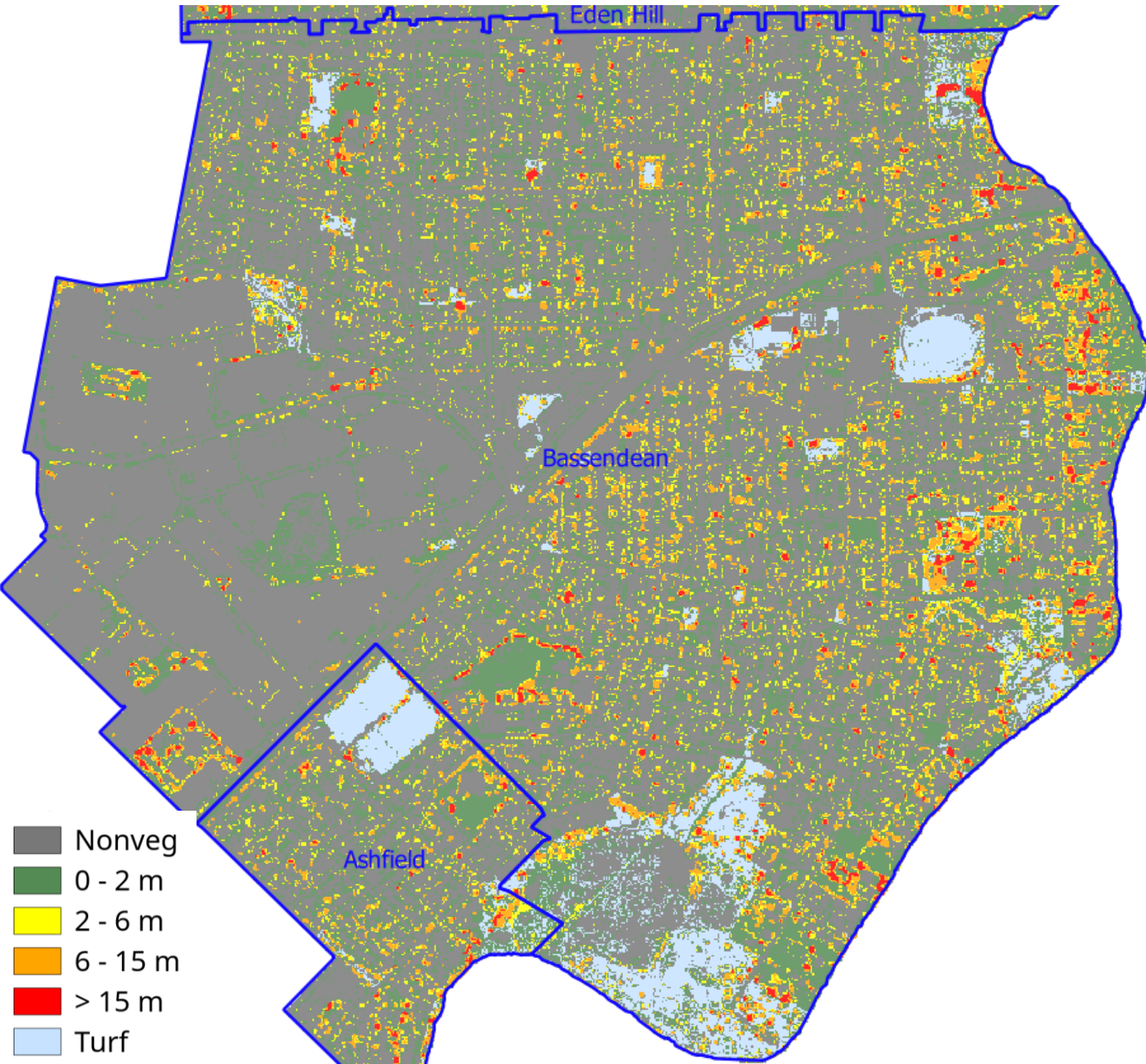

Legend:
- Nonveg
- 0 - 2 m
- 2 - 6 m
- 6 - 15 m
- > 15 m
- Turf

Vegetation Cover	
Nonveg	52%
Turf	9%
0-2m	25%
2m-6m	6%
6m-15m	7%
>15m	1%

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Results – Vegetation Height - Bassendean

Vegetation Cover	
Nonveg	62%
Turf	4%
0-2m	22%
2m-6m	6%
6m-15m	5%
>15m	1%

Legend:
- Nonveg
- 0 - 2 m
- 2 - 6 m
- 6 - 15 m
- > 15 m
- Turf

Eden Hill
Bassendean
Ashfield

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Results – Vegetation Height – Eden Hill

Vegetation Cover	
Nonveg	50%
Turf	7%
0-2m	31%
2m-6m	6%
6m-15m	5%
>15m	1%

All suburbs have similar cover of tall vegetation that contributes to reducing LST

Legend:
- Nonveg (grey)
- 0 - 2 m (green)
- 2 - 6 m (yellow)
- 6 - 15 m (orange)
- > 15 m (red)
- Turf (light blue)

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Key Findings

- Highest LST values found in areas with bare ground, or unmanaged dry turf

- 0-2 m vegetation class does not reduce LST

- 82% of the Town's area does not contain vegetation that reduces LST

- The methods applied here are a cost effective, accurate and repeatable monitoring tool

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Questions?