# Where should all the trees go? – Appendices

Final Report - Appendices
Project Number: NY16005 (Completion: 25th May 2017)

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**Part I**

# Methodology

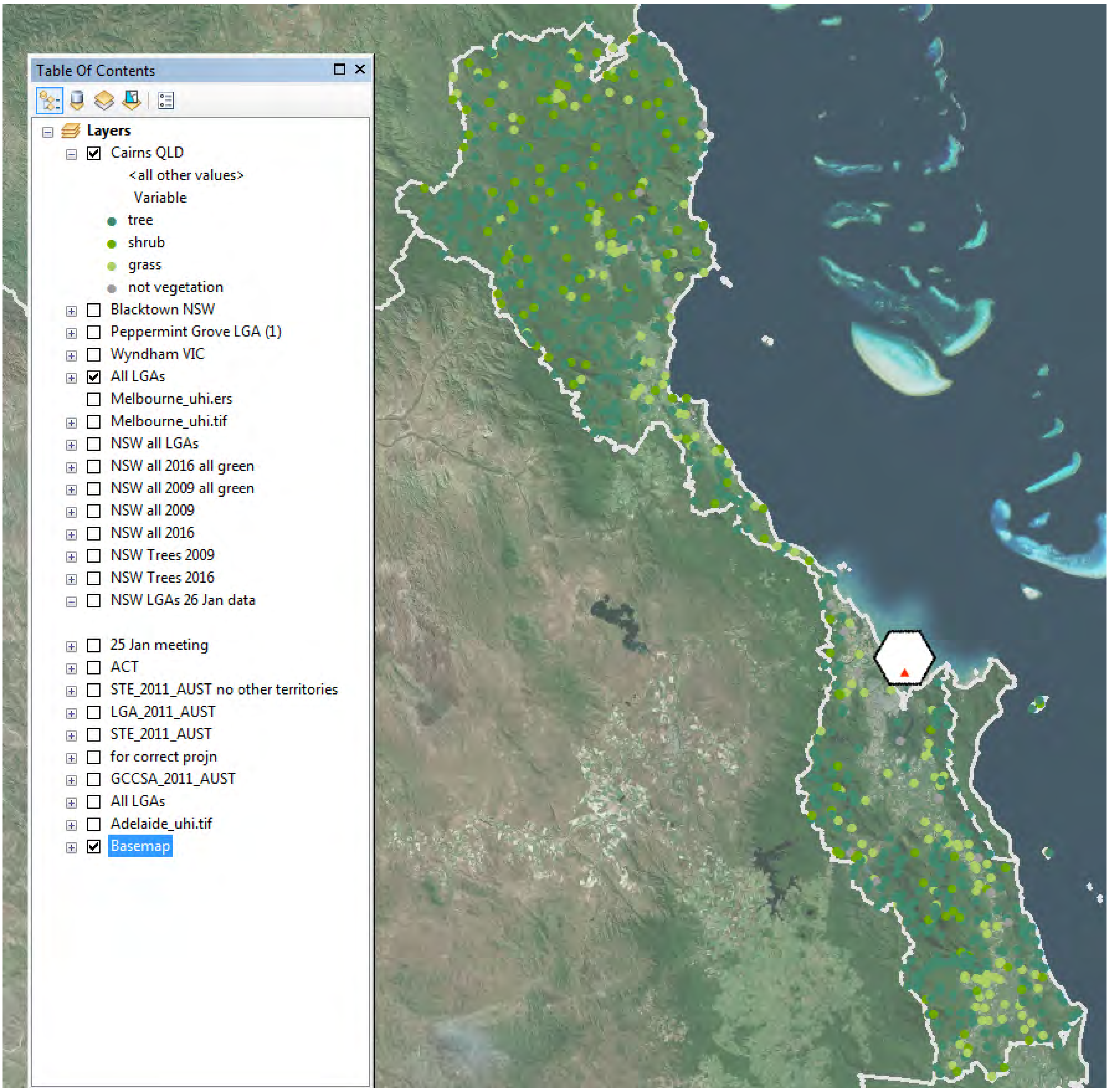
## 1 Introduction

In this part we provide some methodological notes to enable the developer of future benchmarks to understanding some aspects of using i-Tree.

## 2 Errors and features of analysing land cover for LGAs

### 2.1 Widely varying scales among LGAs

A feature of LGAs in Australia are their widely varying scales and locations. Figure 1 shows the variability of the size of LGAs (e.g. Cairns, Blacktown and Peppermint Grove).




Prepared by Kath Phelan: Screenshot from Q-GIS with points used and coloured by land cover type

Figure 1: Screen shot from Q-GIS to illustrate the size of Cairns, Queensland with the white hexagon showing the approximate size of Blacktown, NSW and the red triangle showing the approximate size of Peppermint Grove, WA.

Given the variability in size and land-covers for LGAs the i-Tree derived % change will hide a multitude of effects that range from changes in forestry management, to inner-city gentrification. A 5% change in land cover type identified by an i-Tree study can be very different in terms of causes, in terms of amount of change by surface area and likely effect on population.

## 2.2 Changes to boundaries

In a study that relies on random sampling such as this, data are only comparable when the boundaries from one period to the next are the same.

In the study by Jacobs et al. (2014)[1] the authors used Statistical Subdivision for Brisbane and the ACT because of the large sizes of these two LGAs. However by the time of the 2014 report the SSDs were obsolete. SSDs are a geography comprising one or more SLAs from the previous ABS ASGC. Geographies by ASGC are no longer in use by the ABS and since the 2011 census the ABS only produce statistics by ASGS. The current 2017 report will thus no longer present data by SSD.

Australian Capital Territory data presented by SA3 Due to the size of the ACT LGA, some land cover data by SA3 is also provided. Two SA3s out of eight SSDs from the 2014 report correspond exactly (Woden and Gungahlin-Hall) thus a comparison between report can be made for them.

Presenting data by SA3 will bring the report in line with the ABS ASGS and also enable time series comparisons between future canopy cover reports. It is recommended that releasing data by SA3 will also enable comparisons with other ABS and statistical releases such as from Public Health Information Development Unit (PHIDU).

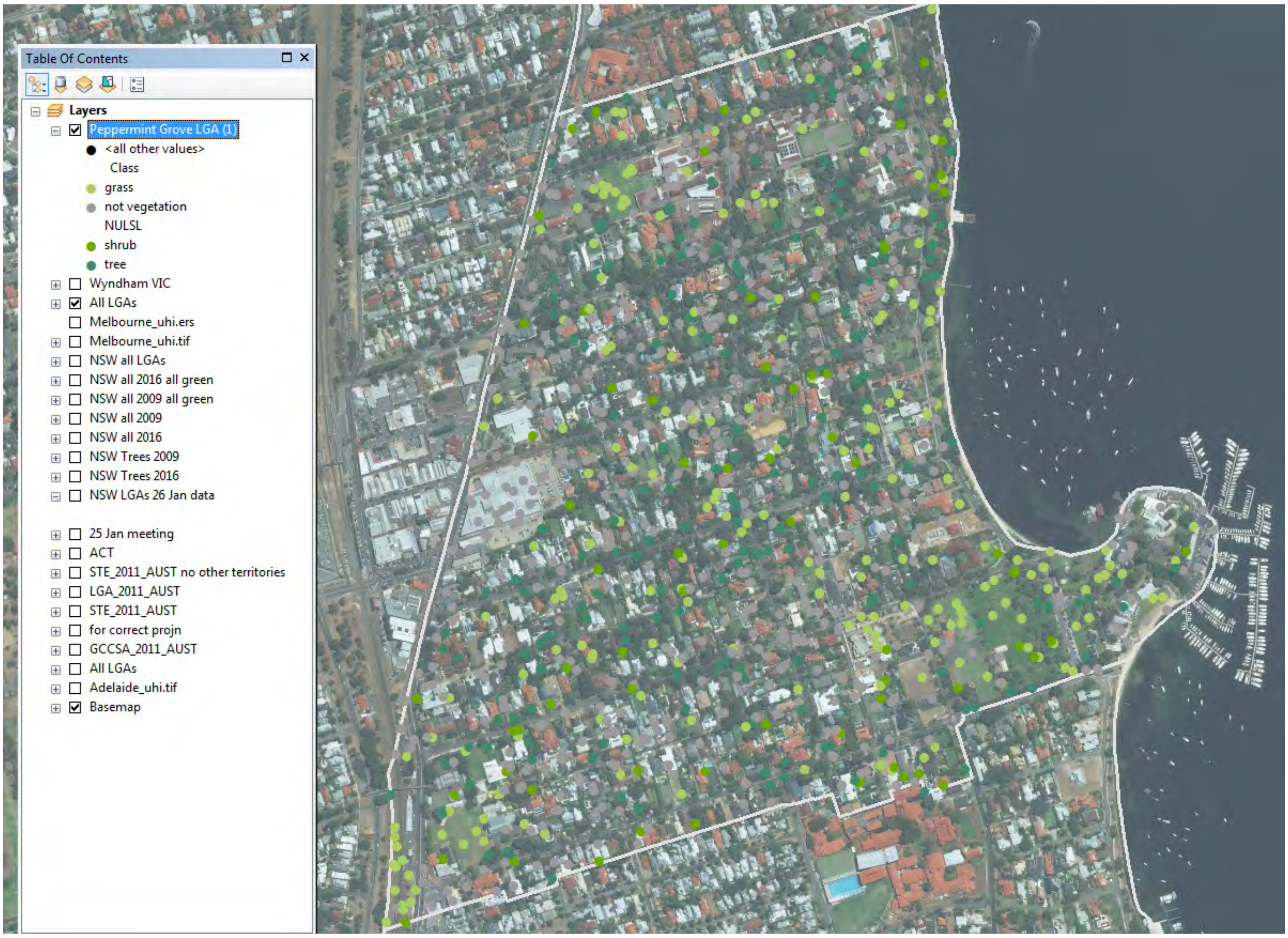
## 2.3 Changing boundaries due to amalgamations

This report was also produced while changes were underway in NSW to amalgamate LGAs. At the time of the production of this report, eight metro LGAs had been newly formed from old metro LGAs. In addition a further six had been proposed but were not yet confirmed and available in ABS geography. Data on land covers were produced for both sets of new NSW LGAs (14 in total).

[1]Jacobs, B., Mikhailovich, N., and Moy, C. (2014) Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment, prepared for Horticulture Australia Limited by the Institute for Sustainable Futures, University of Technology Sydney.

## 3 Human and definitional error

Our study used the same definitions as the previous report which was based on the recommendations of the i-Tree Canopy software manual[2]. In brief, an i-Tree Canopy software requires the use of satelite imagery overlaid with a layer of 1000 points that are randomly located within the boundaries of individual LGAs (Figure 2).




Prepared by Kath Phelan: Screenshot from Q-GIS with points used and coloured by land cover type, Nearmap base layer

Figure 2: Screen shot from Q-GIS to illustrate the 1000 randomly located points coloured by land cover for Peppermint Grove, WA.

Operators are required individually to zoom in on each point and identify whether the point represents one of four categories: Canopy, or anything that looks like a tree; Shrubs, landscaping and even agricultural crops such as vines; Grass, sports fields, paddocks and bare ground; Hard Surface, car parks, train lines etc. The full definition of these surfaces are available on page 11 of the Jacobs et al. (2014) report.

As with the 2014 study we employed 1000 points per LGA and aimed to record the land cover for all the LGAs that were used in the 2014 study (139 in total + 14 new NSW LGAs).

#### 3.0.1 The importance of image timeliness

A feature of the standard i-Tree package is its reliance on freely available Google Earth imagery. While this saves on cost it mitigates against providing a precise time for setting a benchmark. This was demonstrated in the Jacobs et al. (2014) report where the year(s) of the Google Earth imagery used varied between 2008 and 2013 depending on the State being examined.

[2]Jacobs et al. (2014) Op Cit. Full details of the technical aspects of the i-Tree Canopy including user manuals are available at: i-Tree tools

In addition, as Figures 3 shows for points that are located very close to one another, the date can vary in Google Earth. It can also depend on the elevation or amount of zoom.


Prepared by Shirley Famelli: Screenshot from Google Earth

Figure 3: Screen shot of adjacent Google Earth imagery from different dates with the location of sample points in Queensland

## 3.1 How the project's team mitigated these errors

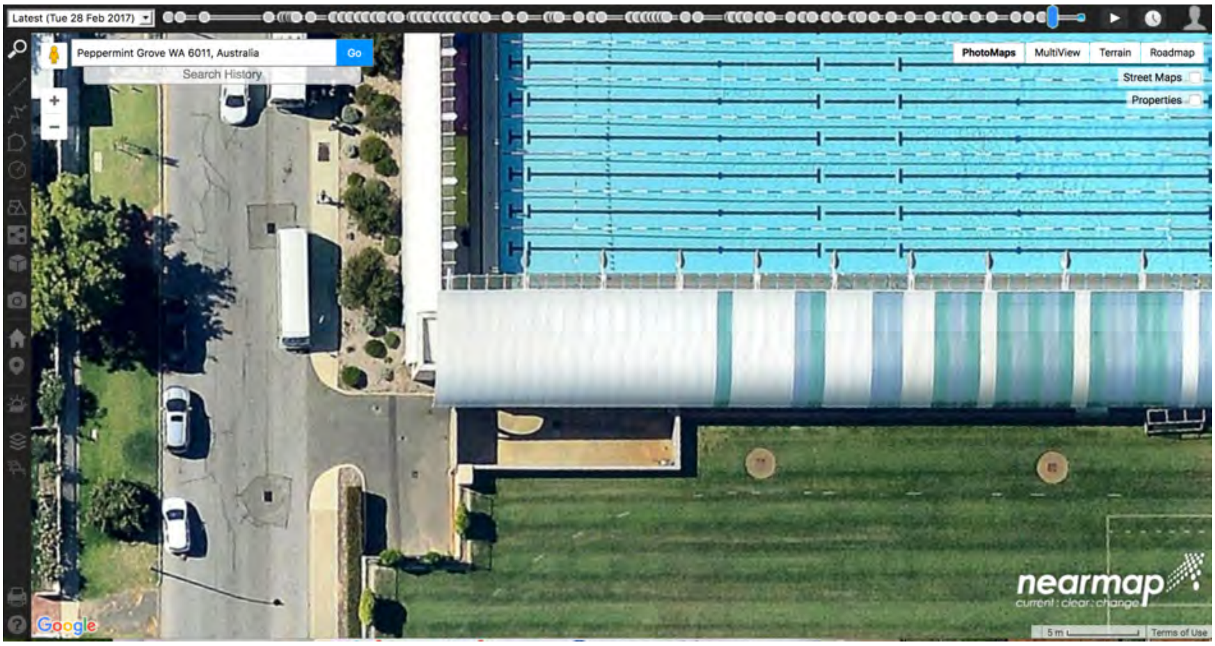
### 3.1.1 Using high resolution images

Instead of using the freely available imagery linked with the online i-Tree canopy tool, this project employed Nearmap imagery that were more recent and are captured at a higher resolution.

Figures 4 and 5 demonstrate this with images zoomed as close as possible on a swimming pool in Peppermint Grove, Perth, WA. As the images show the Nearmap outperforms Google Earth and arguably allows a more precise definition of the difference between shrubs and tree canopy, since this relies on the comparison with other objects to determine the height or the identification of a shadow.


Prepared by Marco Amati: Screenshot from Google Earth

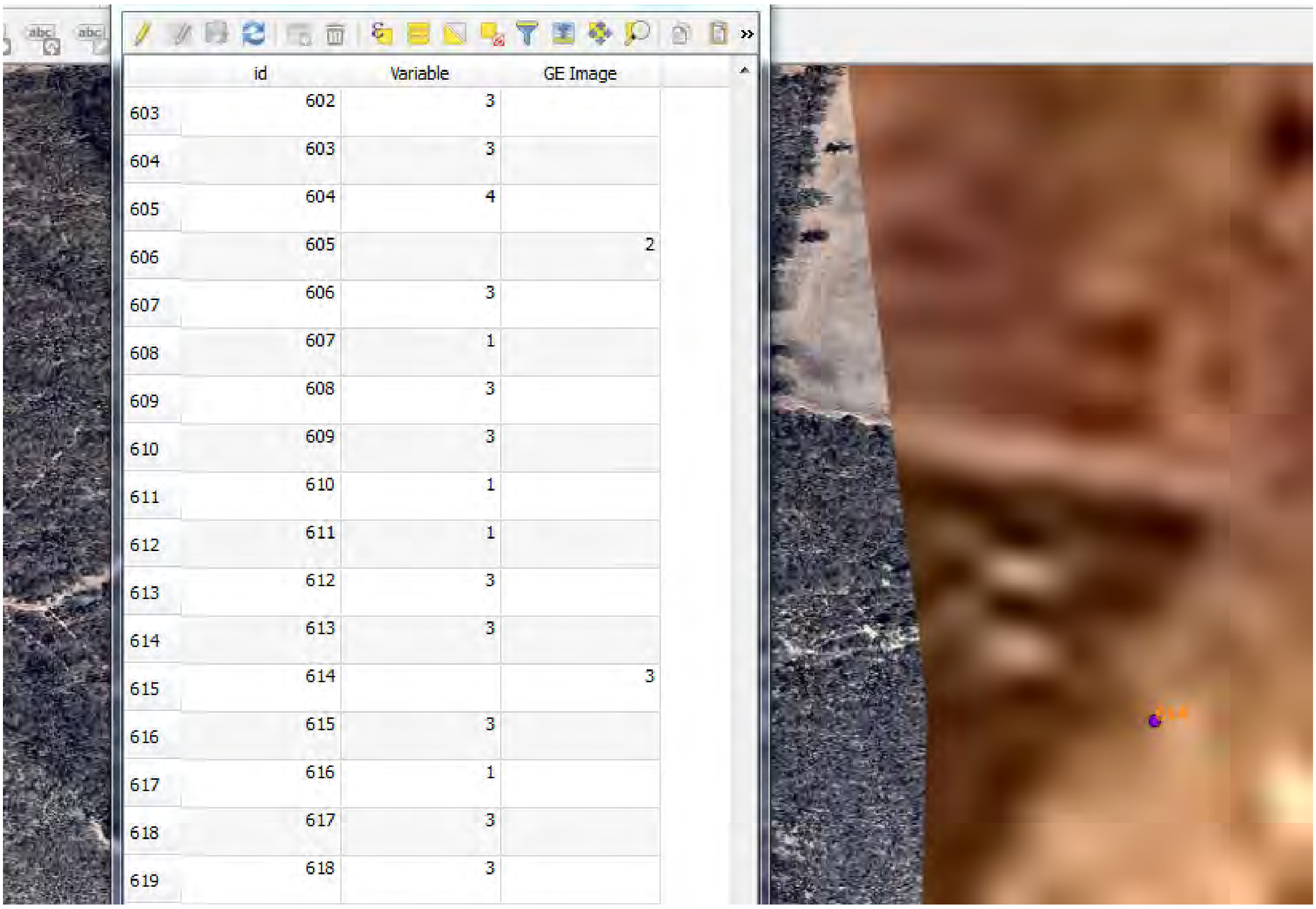
Figure 4: Screen shot from Google Earth of a swimming pool in Peppermint Grove, Perth, WA at highest zoom level. Compare with Figure 5
, in particular the shrubs and trees on the footpath adjacent to the swimming pool.




Prepared by Marco Amati: Screenshot from Nearmap

Figure 5: Screen shot from Nearmap for the same pool as in Figure 4.

Nonetheless a limitation of using this approach is seen in some of the LGAs that include remote areas. This is highlighted in Figure 6 which shows an image for Bendigo, Victoria a large LGA that includes areas of National Park. Here point 14 falls in an area outside the Nearmap coverage. In these cases, Google Earth imagery was used as a surrogate. This however occurred in less than 2% of the points sampled and did not result in a significant level of error due to differences in resolution or timeliness of the imagery.




Prepared by Joe Kaspar: Screenshot from Q-GIS with Nearmap

Figure 6: Screen shot from Q-GIS showing point 14 outside the edge of Nearmap coverage in Bendigo, the Google Earth service was used for point 14.

### 3.1.2 Error checking

Two strategies were used to mitigate against the errors caused by different operator definitions of the classes (e.g. a shrub versus a tree canopy) as well as blunders. The latter could include miskeys in the results, LGA name confusion (e.g. Campbelltown, NSW and Campbelltown, SA) or confusion in the image identification (e.g. a point that landed on a wall with a climbing plant or a point that landed in the middle of a mine shaft).

The first strategy was to assume stability from one period of sampling to the next and therefore to identify all those classes that had had a +/- 5% point swing. The points for these classes were resampled resulting in an additional 50,000 points to check by the team in addition to the initial 139,000 points.

The second strategy was to ensure that no operator would be rechecking their own work and that 'classification' fatigue was limited.

# 4 Sampling and standard error

Author: Joe Kaspar

## 4.1 Background

An additional source of error to those noted above was the error produced in the statistical analysis. This was calculated by first considering that we want to calculate several core statistical metrics:

1. Create a simple random sample of points for each LGA for summer 2016 and assess the category of land cover under each point;
2. Calculate the proportion of points for each category as well as the standard error for each proportion for each LGA in 2016; and
3. Compare the sample derived land cover for each category as a proportion from 2. with the sample derived canopy cover proportion from the 2014 report.

In order to compare the sample derived canopy cover proportions from 2014 and 2016, a different standard error needed to be calculated for the difference between each proportion, similarly a significance test needed to be conducted to test that the difference between the two sample proportions was actual and not through sampling error.

## 4.2 Sample data and error

Two types of sampling error can occur: non-sampling error and sampling error.

### 4.2.1 Non-sampling error

Non-sampling error can occur at any stage of data collection and is primarily a result of processing error by coders, time period bias for the Nearmap imagery, image paralax or inconsistency of the classification of points between reports. These issues can be mitigated through checking, careful training of coders and improving image time consistency however some non sampling errors are unavoidable.

### 4.2.2 Sampling error

As data are collected from a sample but inferences are made about the whole area, the data are thus subject to 'sampling' error. Sampling error thus reflects the difference between the estimate derived in the report from the sample and the 'true value' if a full census of the LGA canopy cover were actually to be conducted.[3]

The two core factors affecting sampling error in this report include:

- Sample size: Larger samples give rise to smaller sampling error;
- Sample/canopy proportion ratio: The larger the sample is as a proportion of the actual canopy cover, the smaller will be the sampling error.[4]

With minimal non-sampling error we can be confident that, if significant, the sample statistic within the standard error range will be within the actual 'true value' due to the central limit theorem.

[3]McLennan, W. (1999) An Introduction to Sample Surveys: A User's Guide. ABS Catalogue no. 1299.0

[4]Parmehr EG, Amati M, Taylor EJ and Livesley SJ (2016) Estimation of urban tree canopy cover using random point sampling and remote sensing methods, Urban Forest Urban Greening, 20, 160–171.

### 4.3 Measuring standard error in the report

Sampling error can be measured mathematically and in this report we primarily present sampling error through the standard error. A standard error is used to present the range of values on the sample statistic that is expected to contain the 'true value' that is being measured by the sample, thus any estimate derived from a sample has a standard error associated with it.[5]

In this report we measure two slightly different types of standard error:

1. The standard error of the canopy cover for each LGA as a result of a sample; and
2. The standard error of the difference between the canopy cover proportions from two different independent samples i.e. the 2014 report $p_1$ and the current 2017 report $p_2$.

### 4.4 Comparisons between reports and the standard error of the difference

If the proportion of canopy cover between reports is different for each LGA, this does not necessarily mean that there has been a change, the difference may be due to statistical error. Both the 2014 report and the 2017 report used different simple random samples within the same sample frame (i.e. LGA), thus each sample was considered an 'Independent sample'. When comparing the proportions between two independent samples (i.e. $p_1$ and $p_2$) a hypothesis test should additionally be conducted to ascertain that there has in fact been a change. When describing the change between the reports a standard error of the difference should also be presented.[6]

In this report the standard error for the difference between each proportion was calculated in two discrete equations.

Step 1: Calculate the pooled standard deviation (weighted average) for the difference between each report LGA: when comparing two proportions for both independent samples, the variances (and therefore the standard deviations) for each sample will be similar, thus a pooled standard deviation (i.e. a weighted average) is used in the equation [7].

$$\hat{p} = \frac{\hat{p_1}n_1 + \hat{p_2}n_2}{n_1 + n_2}$$

Step 2: Calculate the standard error of the difference between the two proportions

$$SE_0 = \sqrt{\frac{\hat{p}(1-\hat{p})}{n_1} + \frac{\hat{p}(1-\hat{p})}{n_2}} = \sqrt{\hat{p}(1-\hat{p})(\frac{1}{n_1} + \frac{1}{n_2})}$$

#### 4.4.1 Hypothesis test through a two-Independent-Samples T Test

The null hypothesis for each canopy cover proportion will be that the difference between each time periods i.e. 2014 ($p_1$) and 2017 ($p_2$) is 0.

$H_0$: $p_1$ canopy cover % = $p_2$ canopy cover %

$H_1$: $p_1$ canopy cover % $\neq$ $p_2$ canopy cover %

To calculate the p value the z score is first needed.

$$z = \frac{(\hat{p_1} - \hat{p_2}) - 0}{SE_0}$$

If $p<0.05$ then we can reject the null hypothesis and can assert that there is a difference between the two sample statistics (i.e. 2014 and 2017 are different with a 95% certainty).

[5]McLennan 1999 Op Cit.

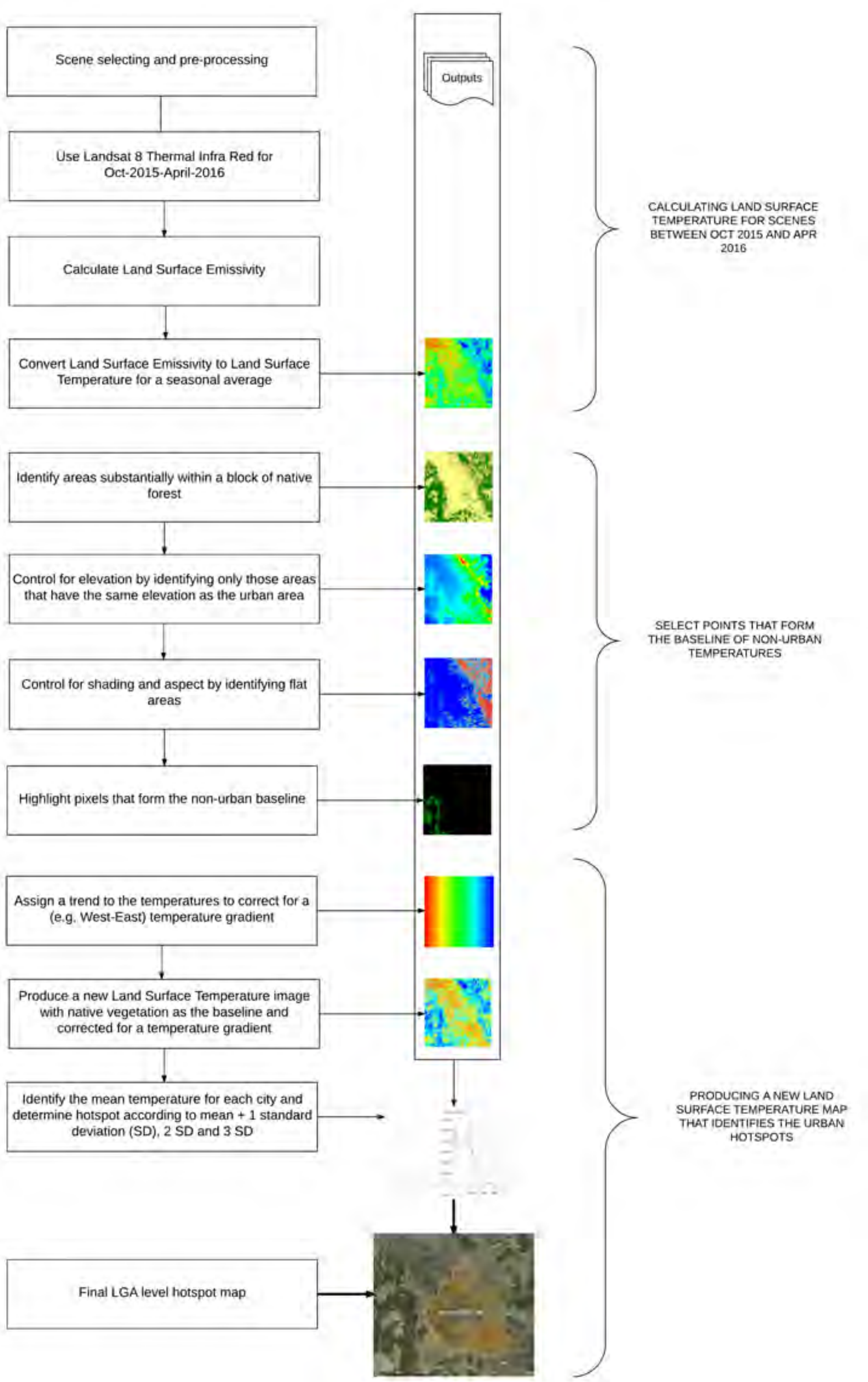
[6]Gravetter, F. & Wallnau, L. (2000) Statistics for the Behavioural Sciences 5th edn. Wadworth Tomas Learning: USA.

[7]Gravetter & Wallnau 2000 Op Cit.

# 5 Producing and analysing the urban heat island data

## 5.1 Producing the data

A key part of the project was the production of urban heat island data for all of the LGAs studied (Figure 7). Devereux and Caccetta (2017) detail the full version of the methodology.[8]




Prepared by Marco Amati based on Devereux and Caccetta (2017)

Figure 7: Flowchart of steps required to produce urban heat island maps

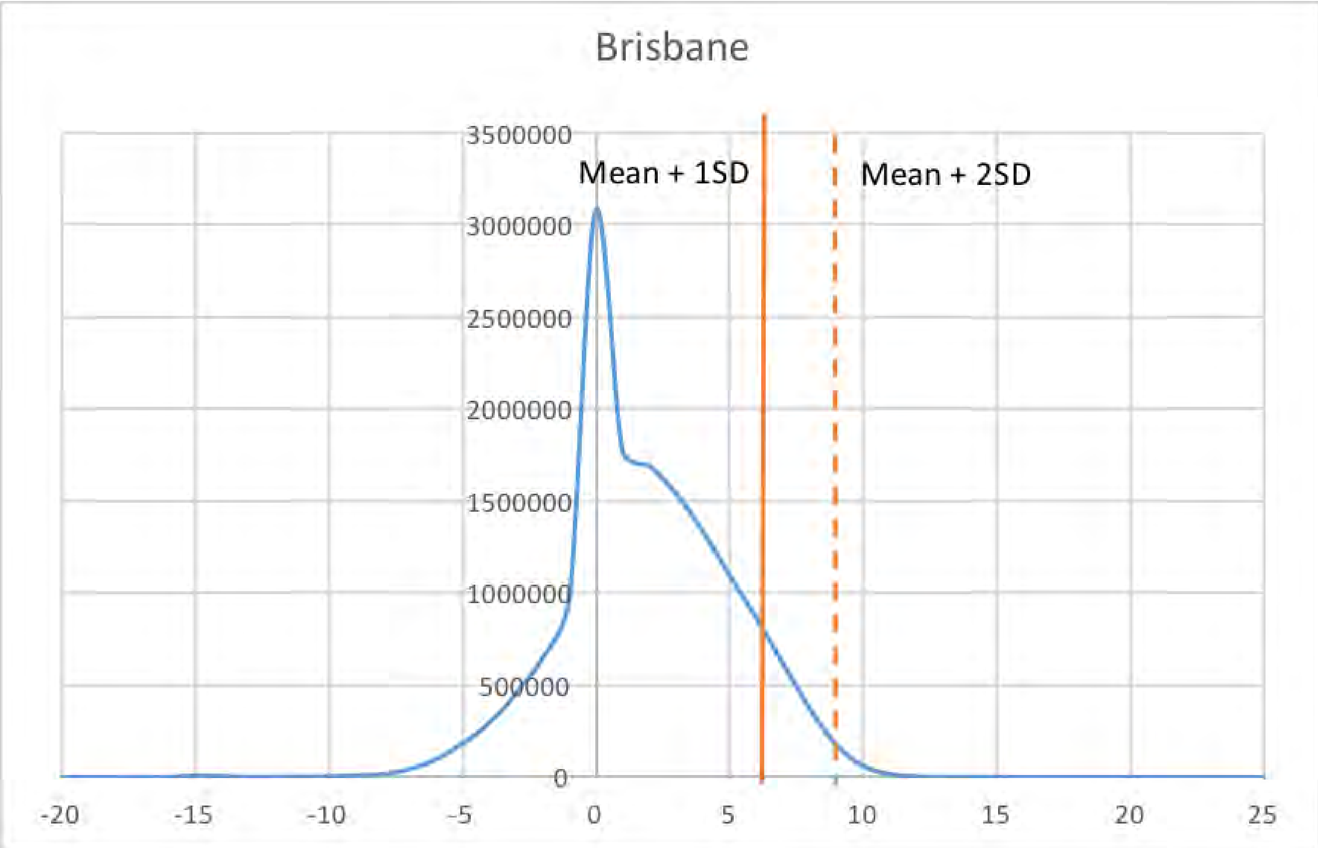
[8] Devereux D and Caccetta PA (2017) Estimation of Land Surface Temperature and Urban Heat Island effect for Australian urban centres. Report CSIRO Data61, Australia.

## 5.2 Identifying urban hotspots

Various approaches were trialled to allow the mapping and identification of hotspots, including setting the hotspot definitions by quintiles. A significant challenge here was the variability in the locations that were mapped. These include tropical locations or large LGAs with relatively uniform land cover. In these cases dividing the temperature into quintiles produced an unrealistic hotspot map that 'forced' the identification of hotspots when in reality the temperature differences were quite minor.

Figures 8, 9 and 10 demonstrate the variability of the temperatures across the three largest cities in the study: Brisbane, Melbourne and Sydney. For Brisbane as noted in the report by Devereux and Caccetta (2017)[9], artefacts were created as part of the identification of temperature. This leads to a small number of extreme temperatures. To allow the spread of data to be better visualised the axes were set at the same limits.

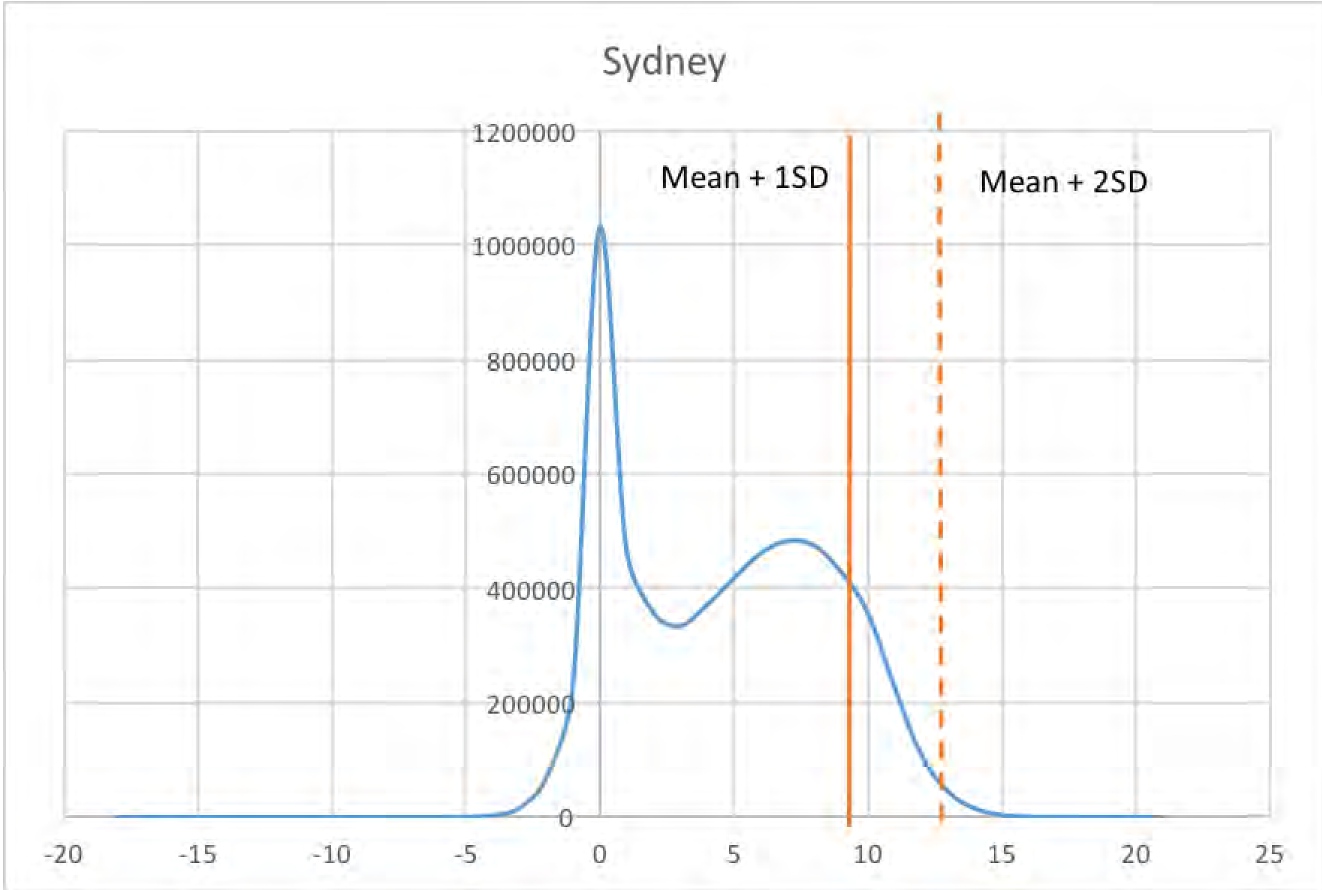
Consistent with a tropical climate, Brisbane shows a much lower spread of temperatures than either Sydney or Melbourne. Sydney and Melbourne both have peaks of temperature frequency that are outside 0 degree centigrade for native vegetation. To take account these different histogram shapes and the ranges of temperature, while adopting an approach that is consistent across all of the sample areas it was decided to use mean + 1 standard deviation (SD) to set the level of a hotspot with +2 SD and +3SD for the extremes. This results in a slightly different hot spot temperature for each metropolitan area.




Prepared by Alex Saunders. NB: axis has been set at a minimum of -20 deg. C and a maximum of + 25 deg. C. However the true range of values was -82 – 28 deg. C

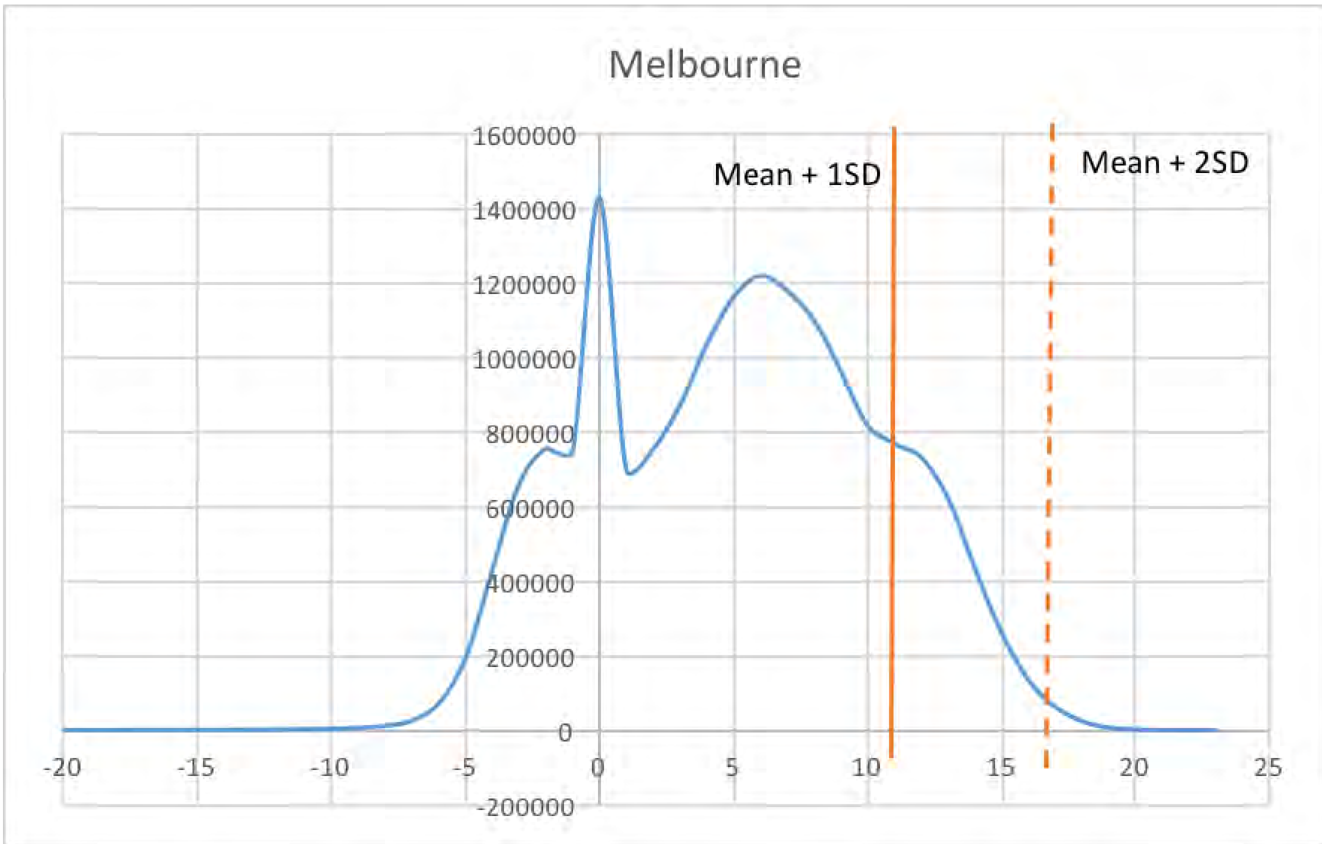
Figure 8: Distribution of frequency of cells according to temperature for Brisbane. Red lines show the temperature of a low level and a medium level hotspot

[9]Op Cit.




Prepared by Alex Saunders. NB: axis has been set at a minimum of -20 deg. C and a maximum of + 25 deg. C. However the true range of values was -18 – 21 deg. C

Figure 9: Distribution of frequency of cells according to temperature for Sydney. Red lines show the temperature of a low level and a medium level hotspot




Prepared by Alex Saunders. NB: axis has been set at a minimum of -20 deg. C and a maximum of + 25 deg. C. However the true range of values was -41 – 23 deg. C

Figure 10: Distribution of frequency of cells according to temperature for Melbourne. Red lines show the temperature of a low level and a medium level hotspot

## 6 Combining all the information to produce an index of vulnerability

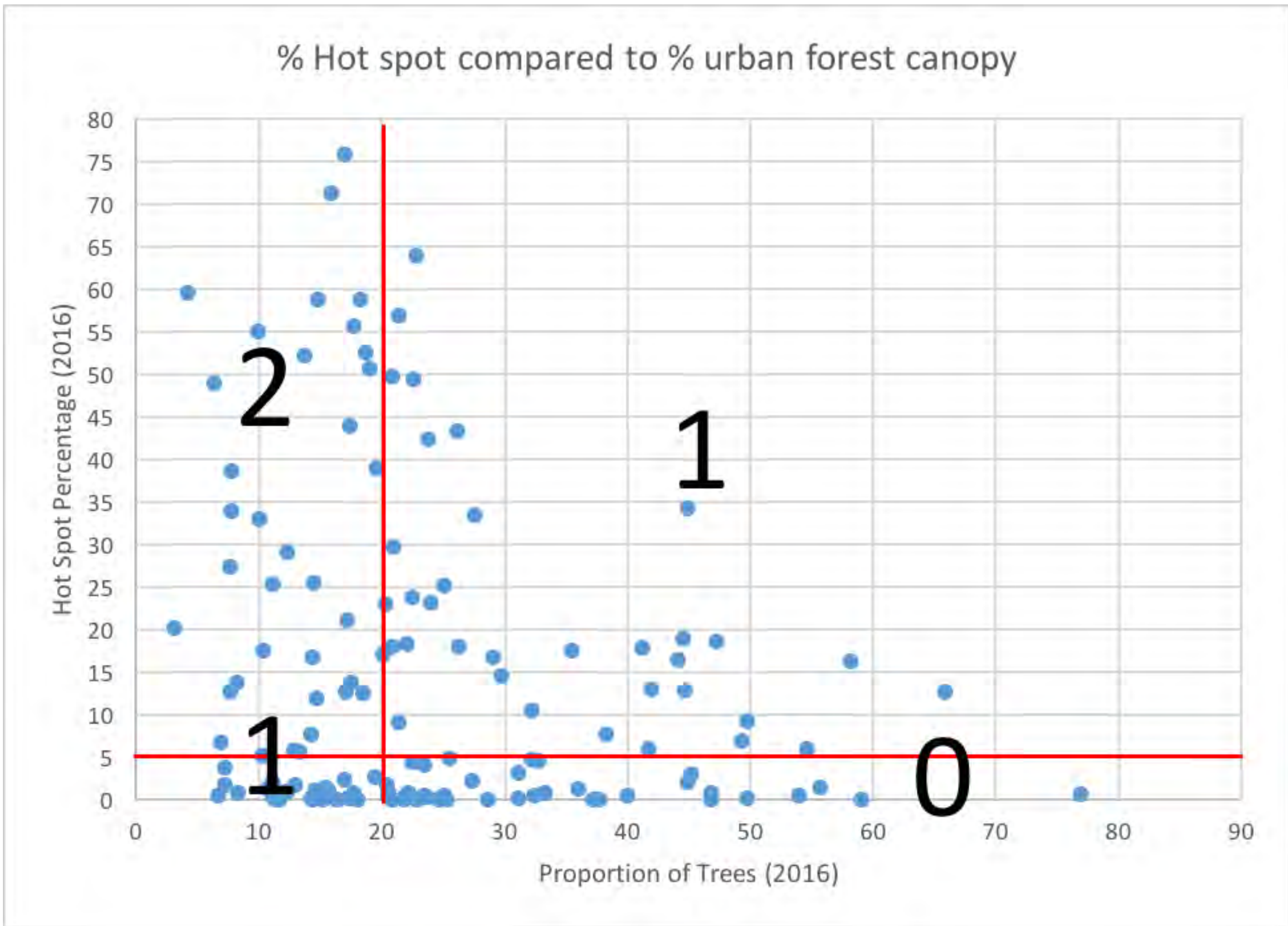
A significant challenge was identified early on in the project with combining the key data sets that represent different scales, different time periods and are produced at different time scales. For example, health data is generated as a result of complex patterns of lifestyle and opportunity over the course of years. Land cover data may only be a small part of that variability.

After extensive consultation withing the research team and with the 202020 Vision team it was decided to adopt a quadrant approach to developing the index. This consisted of:

1. Pairing two variables to examine their relationship using an X Y scatter plot.
2. Identify the median value on both axes.
3. Divide the scattered data into a quadrant.
4. Identify the direction of the variables that represent lower vulnerability.
5. Give two points to those LGAs that fall into the quadrant that is lowest vulnerability.
6. Give one point for those LGAs that are in the quadrant next to the one with lowest vulnerability (i.e. that have high vulnerability for one variable and low vulnerability for the other).
7. Give no points for LGAs that are in the quadrant that is highest risk.

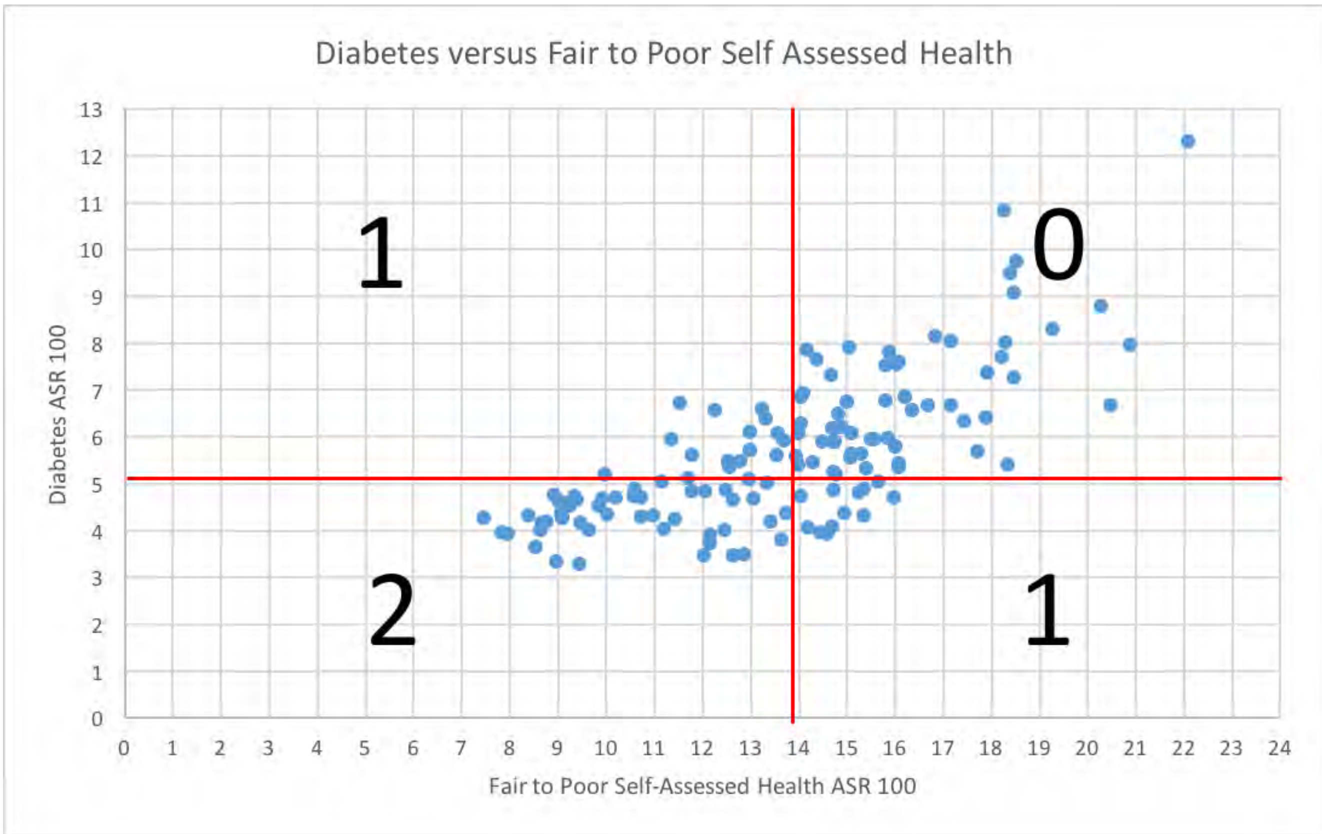
Figure 11 illustrates this method using the data from canopy % and urban hotspot %. It shows the trend as expected is downward with LGAs that have low canopy cover experiencing a greater coverage of urban hotspots. However at the same time, there are many LGAs that have no hotspots despite having little canopy cover. This is because the % urban hotspots are due to the influence of other types of greenery such as shrubs and the presence of water bodies. There is a clear association between the presence and size of hotspots and the roofs of large warehouses and pieces of infrastructure. It may be that only a small amount of canopy cover in residential areas and a lack of large pieces of unshaded infrastructure is what is needed to ensure the coolness of an area.

Figure 12 shows a similar process with the rate of self-assessed fair to poor health rising with the prevalence of diabetes. The SEIFA indices also show that they rise together. This is not surprising since SEIFA IRSD and SEIFA IER share 4 variables (Figure 13). The graph of rate of change of canopy loss versus total green cover loss does not show any evident trend (Figure 14). Finally, the % population under 5 is plotted against the % population greater than 65 who live alone to identify the sections of the population with a greater risk of vulnerability (Figure 15).



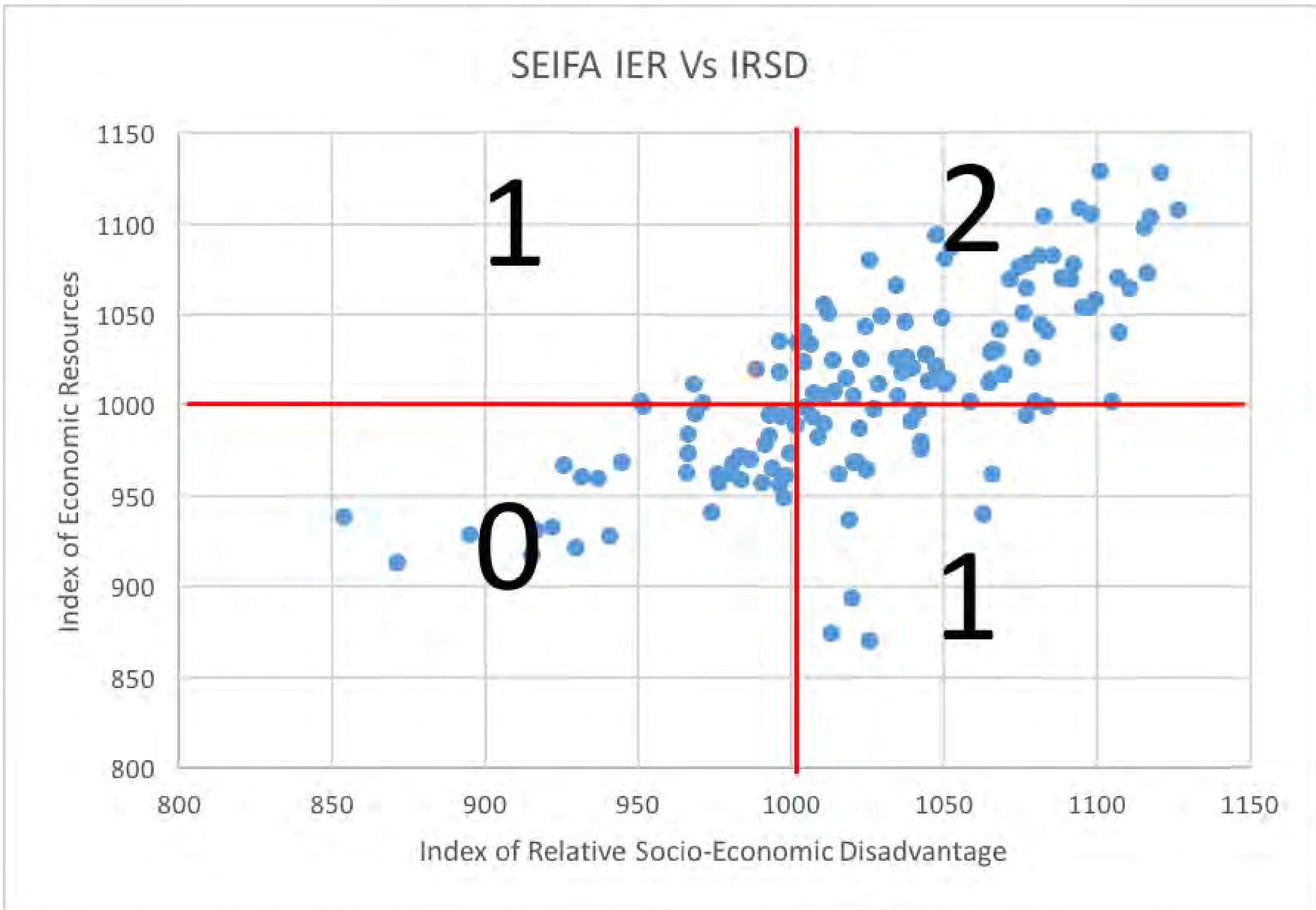

Prepared by Marco Amati

Figure 11: Graph of % hotspot in each LGA by % canopy cover



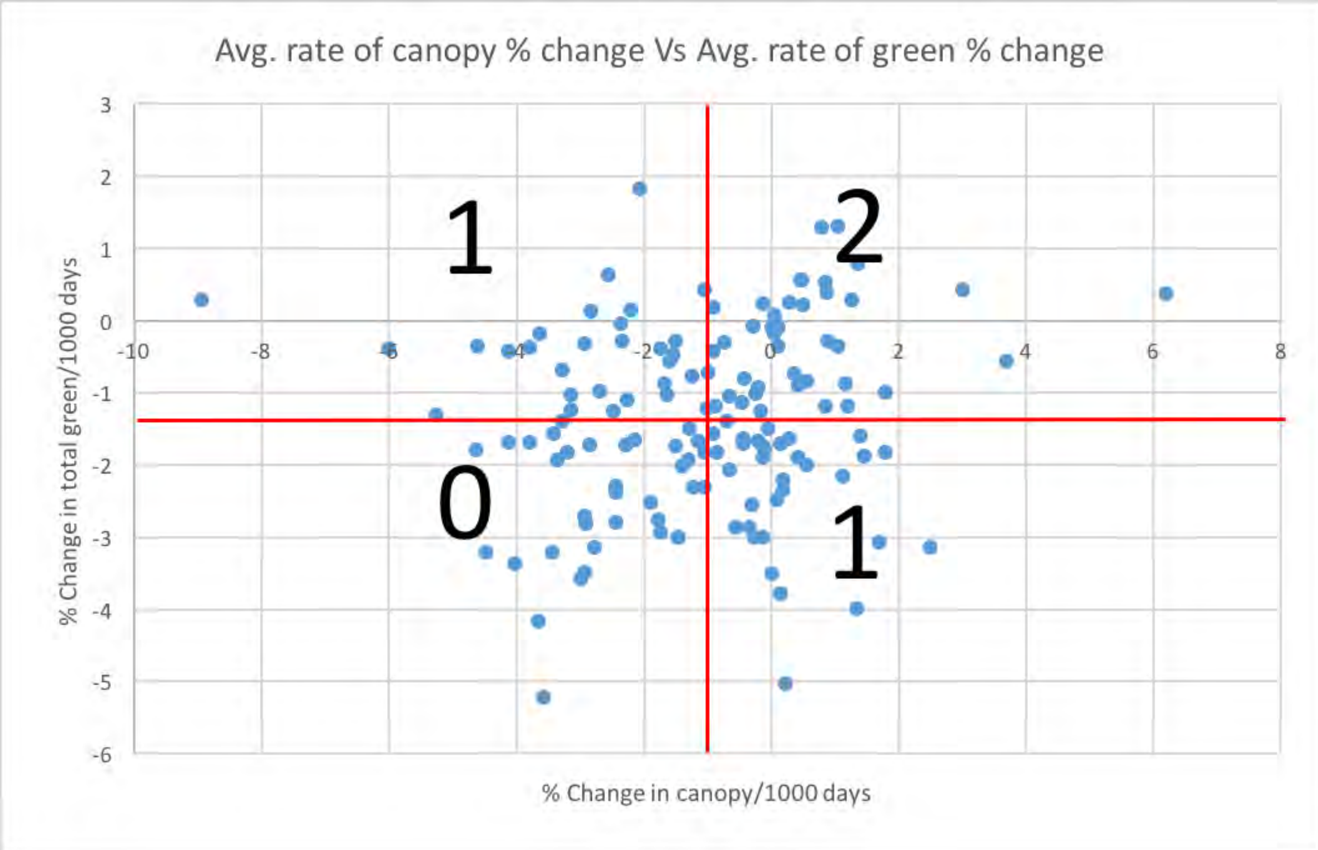

Prepared by Marco Amati

Figure 12: Graph of Self-Assessed Health by ASR100 for each LGA by Prevalence of diabetes by ASR100



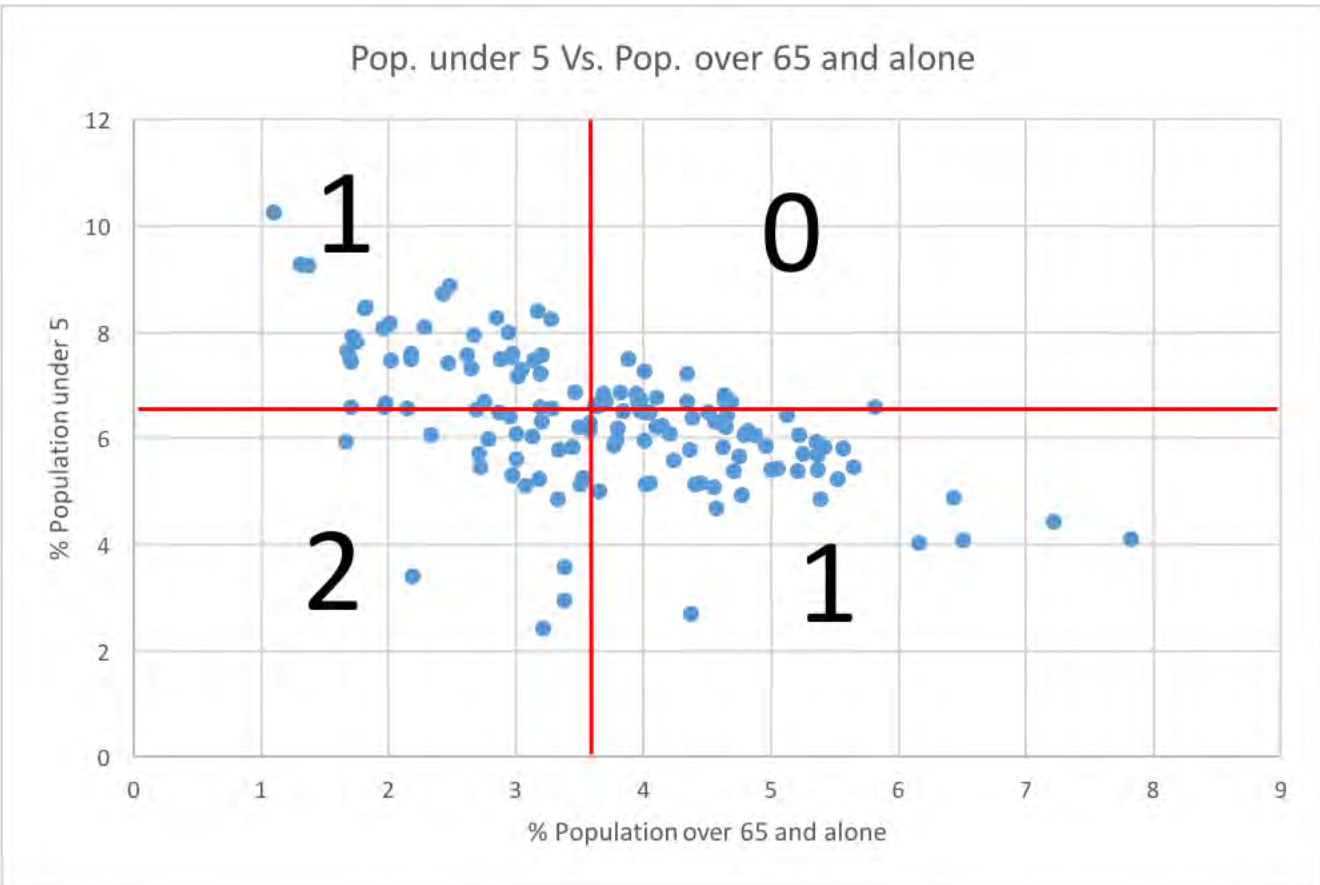

Prepared by Marco Amati

Figure 13: Graph of SEIFA Index of Relative Socio-Economic Disadvantage in each LGA by SEIFA Index of Economic Resources




Prepared by Marco Amati

Figure 14: Graph of the rate of total green loss in each LGA by canopy cover loss




Prepared by Marco Amati

Figure 15: Graph of the rate of % population under 5 in each LGA versus % population over 65 and living alone

# Part II
# Results

# 1 State results of canopy and total green cover 2008-2013 – 2016

## 1.1 Summary

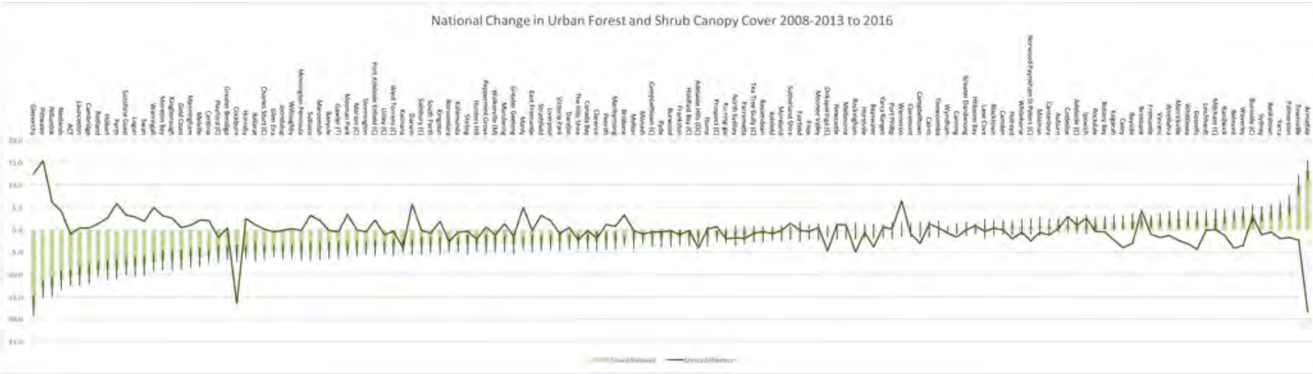
Overall the results display two consistent trends across both set of graphs for canopy and green cover change. For tree canopy there is evidence of natural exchange between the canopy class and the shrubs. This is shown nationally for the loss of canopy in Figure 16, page 24 and Figure 20, page 26. They show, for example, that Pittwater and Warringah LGAs both lost significant amounts of canopy cover during the five years from 2009–2016. However, these losses are offset by gains in shrub cover (or saplings) during the same period.

Interpreting tree canopy as an indicator of urban greening should be treated with caution, especially in an i-Tree study such as this. As well as the differences between operators differentially identifying trees and shrubs, there is a natural exchange between shrubs and trees over a given period. Trees and shrubs are subject to dieback and so will leave opportunities for the growth of one or the other. A bushfire or drought will reduce the canopy cover but allow shrubs or juvenile trees that look like shrubs to grow back. Since many of the metro LGAs in Australia contain extensive areas of national park some are particularly susceptible to these natural fluctuations.

While canopy cover can be argued in a few limited cases to be increasing (factoring in losses of shrubbery) the figures for total green cover paint a starker picture. None of the LGAs have increased their green land cover over the period studied by a significant amount (Figure 17, page 24). and the majority have lost green cover. For example the total surface area of all the LGAs studied is 61,001 square kilometers. In total the green surface area declined by 2.6% over the period studied. This equates to a total loss of 1,586 square kilometres, or an area equivalent to the size of the City of Brisbane.

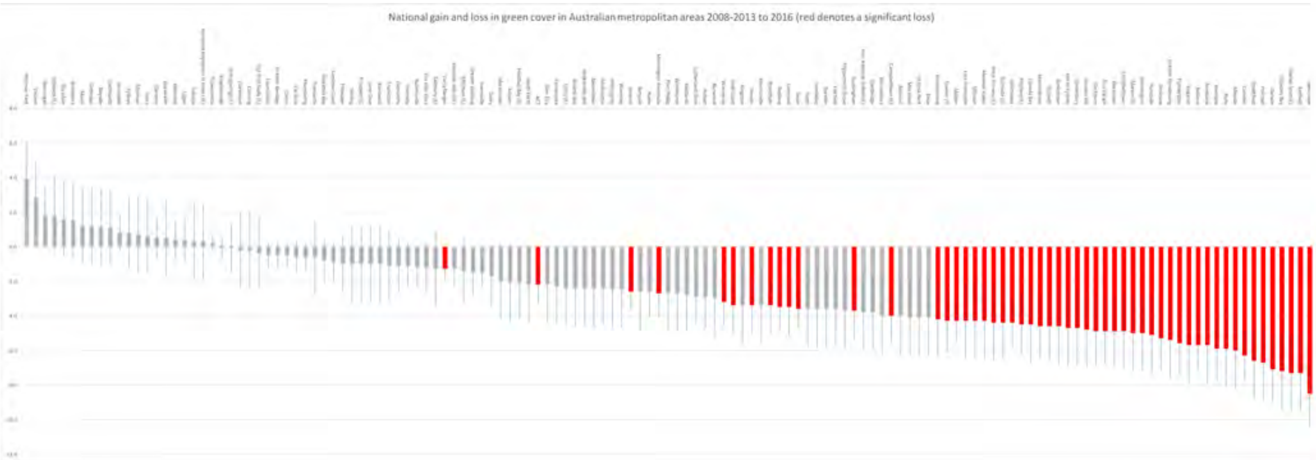
Just as remarkably, looking through the LGAs that have lost green cover there appears to be no consistent trend for where these losses are coming from. For example, the largest percentage decreases are not happening in peri-urban or inner-city areas but are happening in all the States and in all variety of different LGA location. This green cover loss would therefore be resultant from a variety of processes that range from legislation to reduce tree cover in the event of a bushfire; subdivision of large suburban blocks; consumer trends in housing towards smaller gardens; risk aversion of local governments towards trees and falling branches and green field development on the edge of urban areas.

## 1.2 Figures for national canopy and green cover change




Prepared by Marco Amati

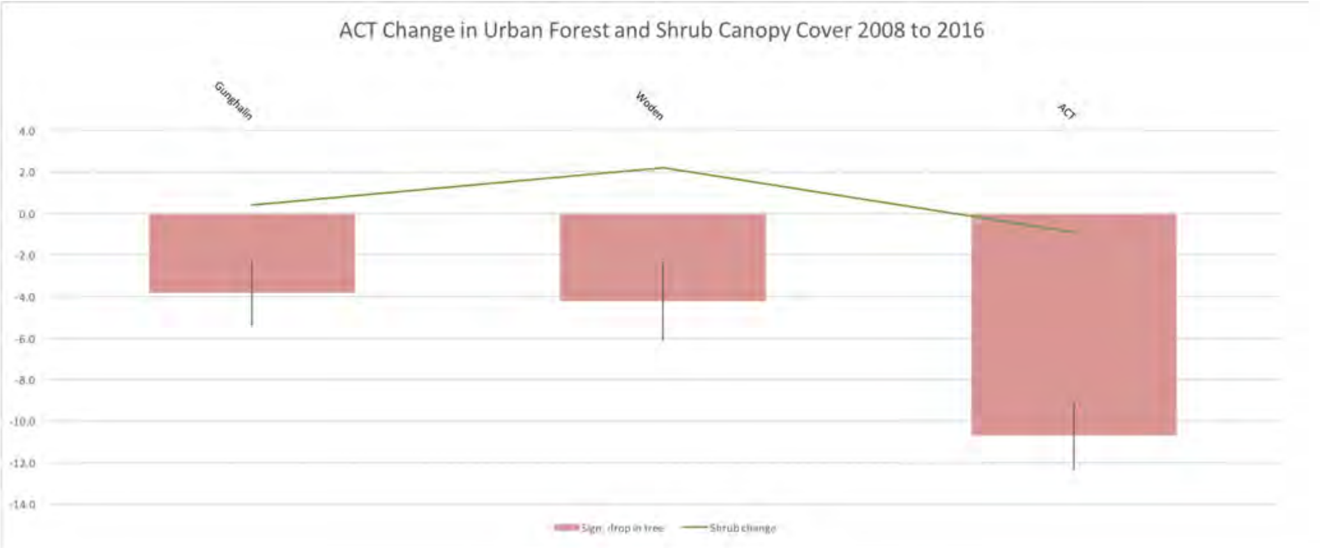
Figure 16: Changes in Canopy and Shrubs for all LGAs in the study 2008-2013 – 2016




Prepared by Marco Amati

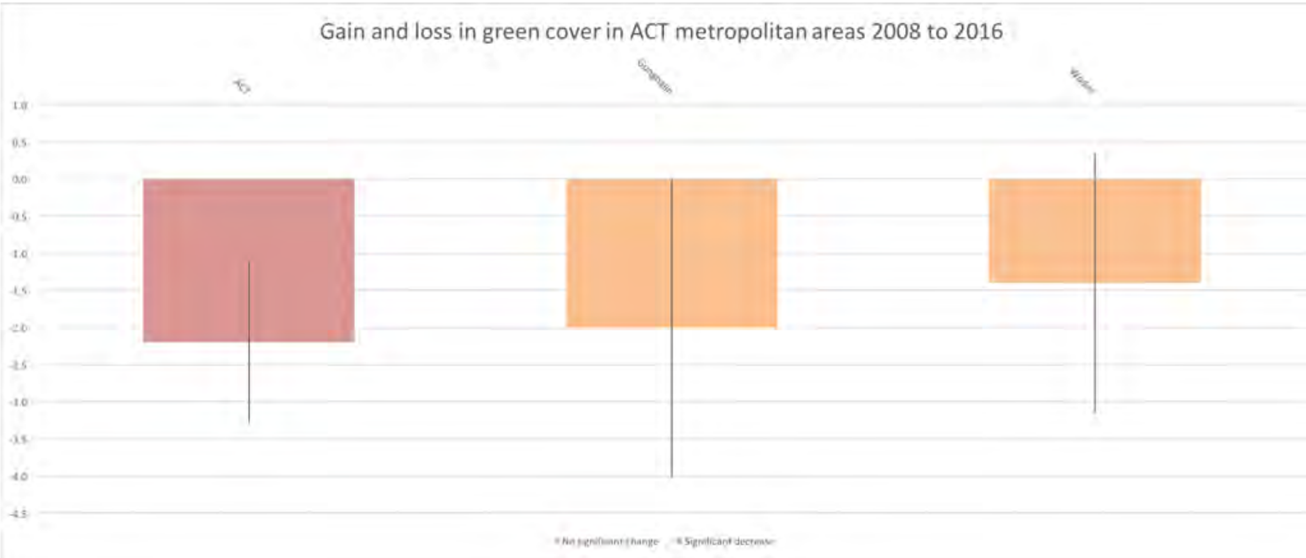
Figure 17: Changes in total green cover across all of the LGAs 2008-2013 – 2016. Red denotes a significant loss.

## 1.3 State by state changes in canopy and total green cover change



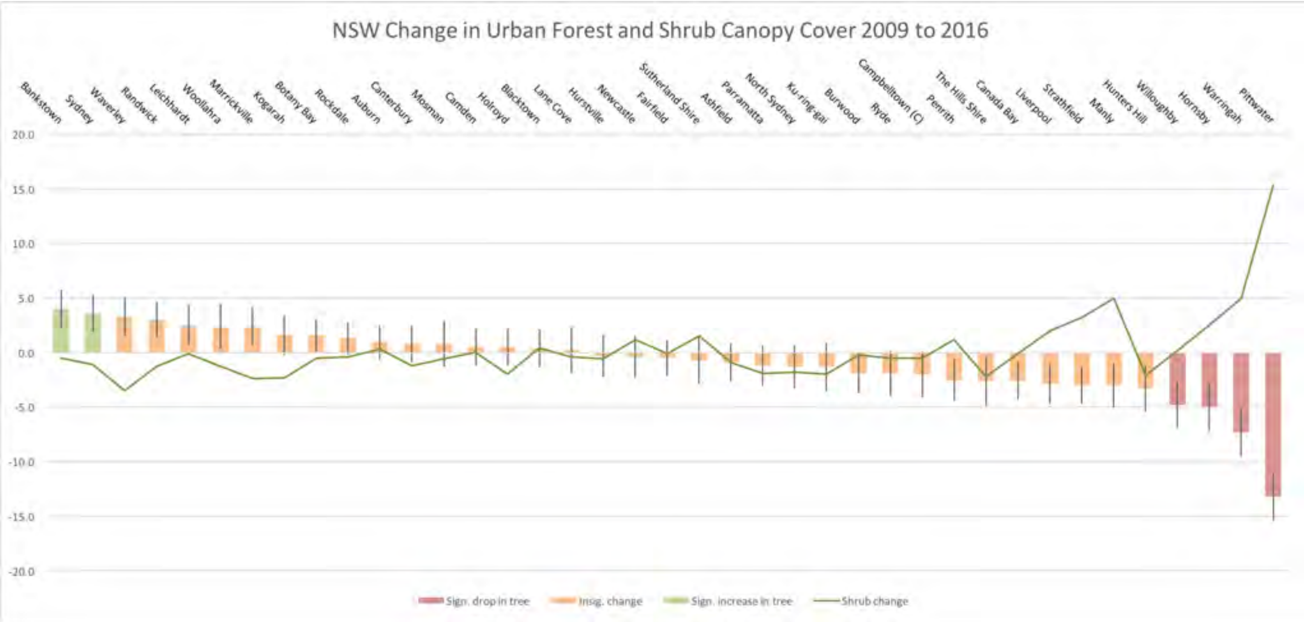

Prepared by Marco Amati

Figure 18: Changes in Canopy and Shrubs for the ACT 2008-2016



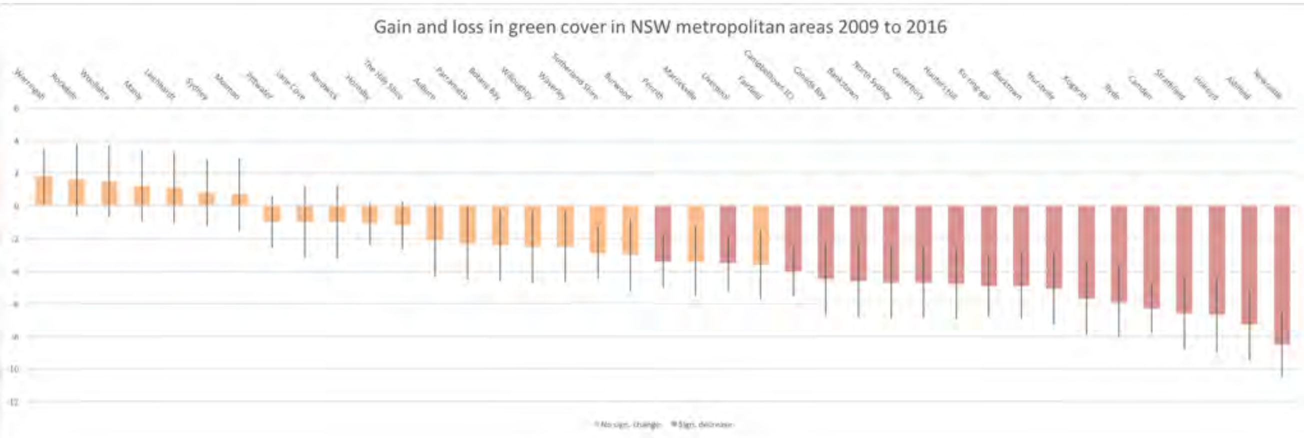

Prepared by Marco Amati

Figure 19: Changes in total green cover for the ACT 2008-2016



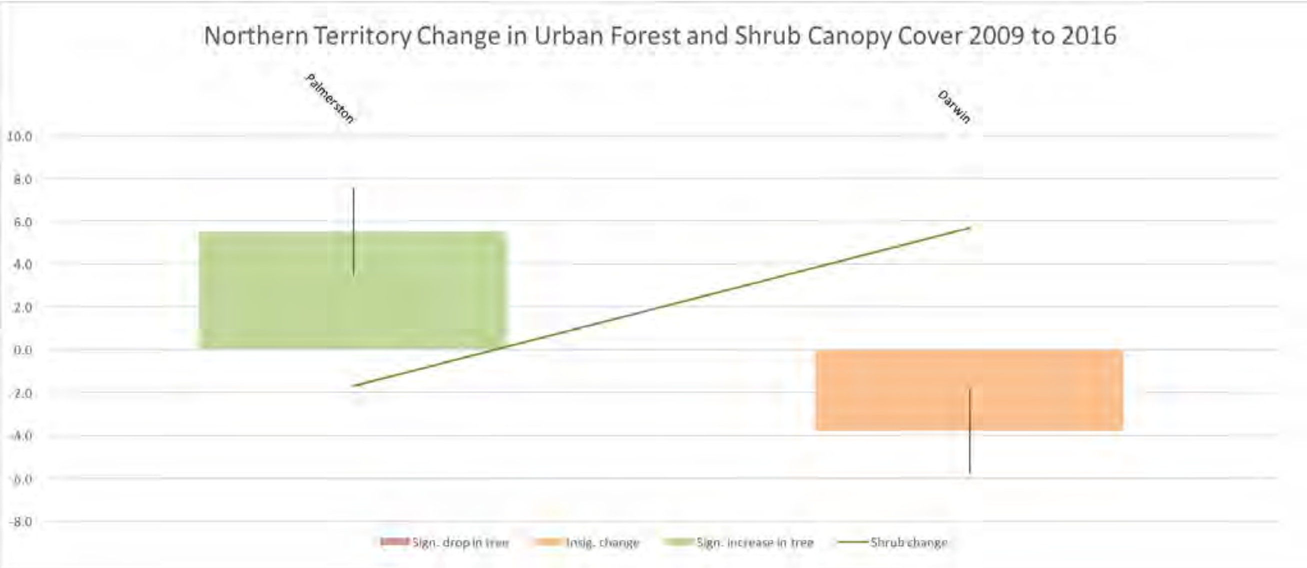

Prepared by Marco Amati

Figure 20: Changes in Canopy and Shrubs for NSW 2009-2016



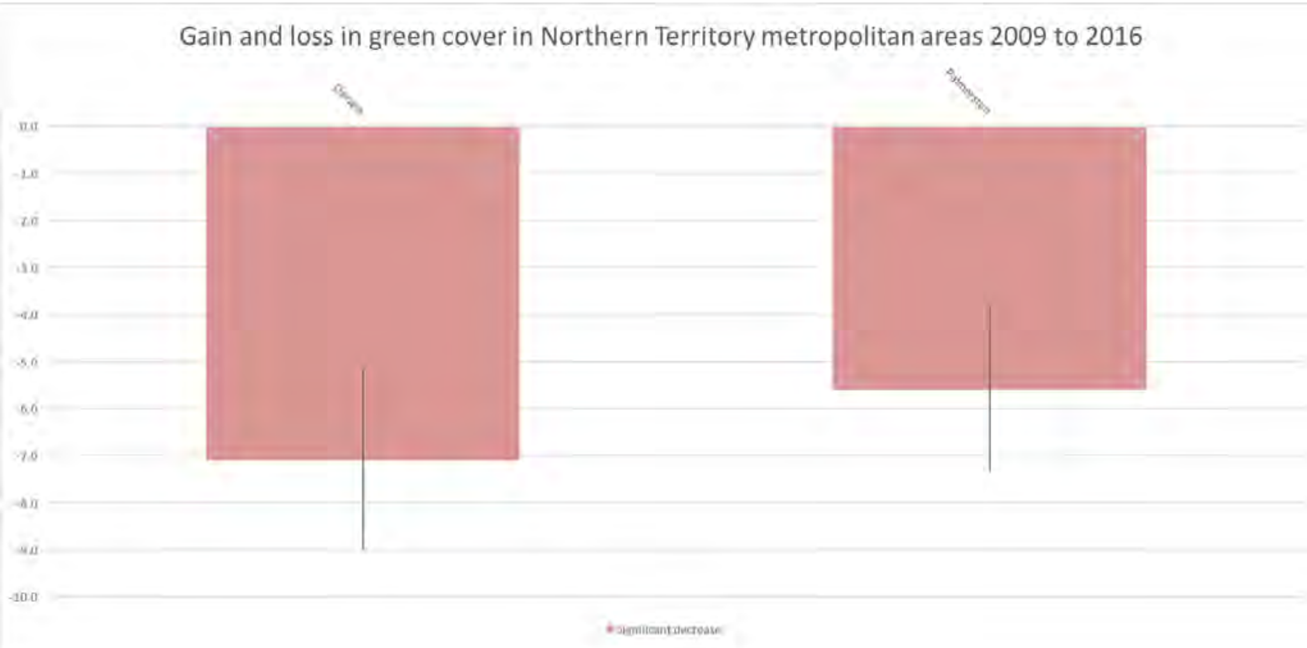

Prepared by Marco Amati

Figure 21: Changes in total green cover for NSW 2009-2016



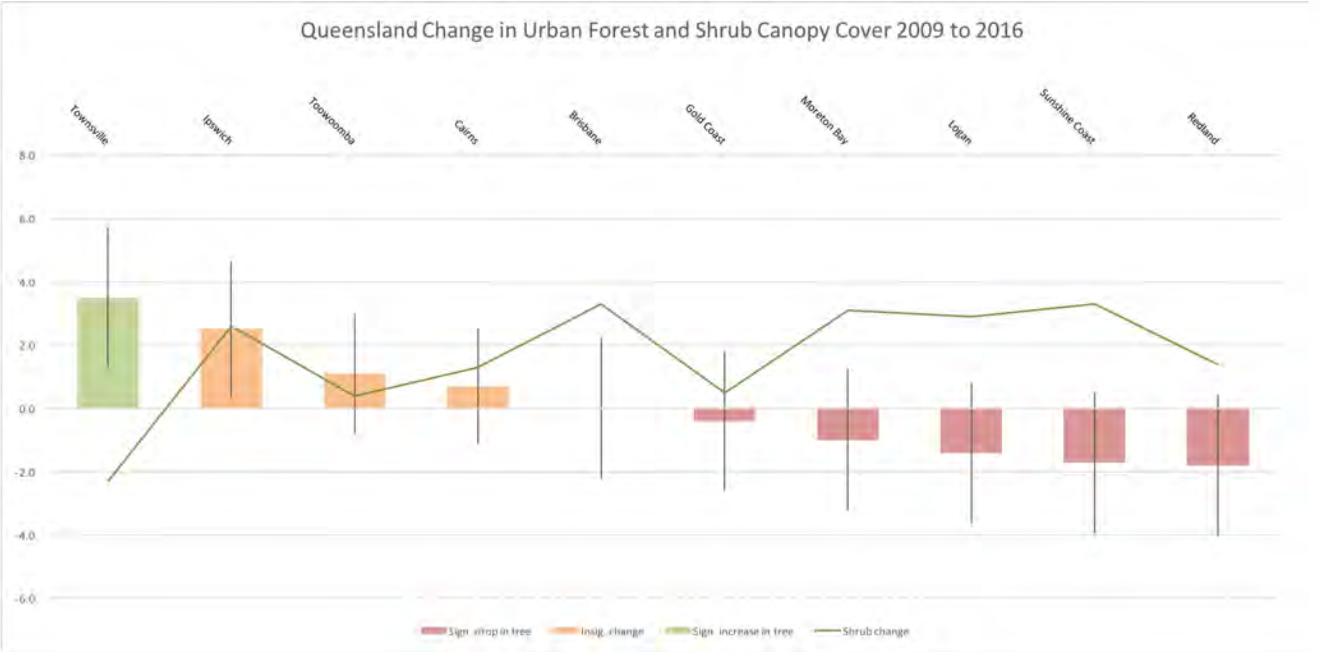

Prepared by Marco Amati

Figure 22: Changes in Canopy and Shrubs for NT 2009-2016



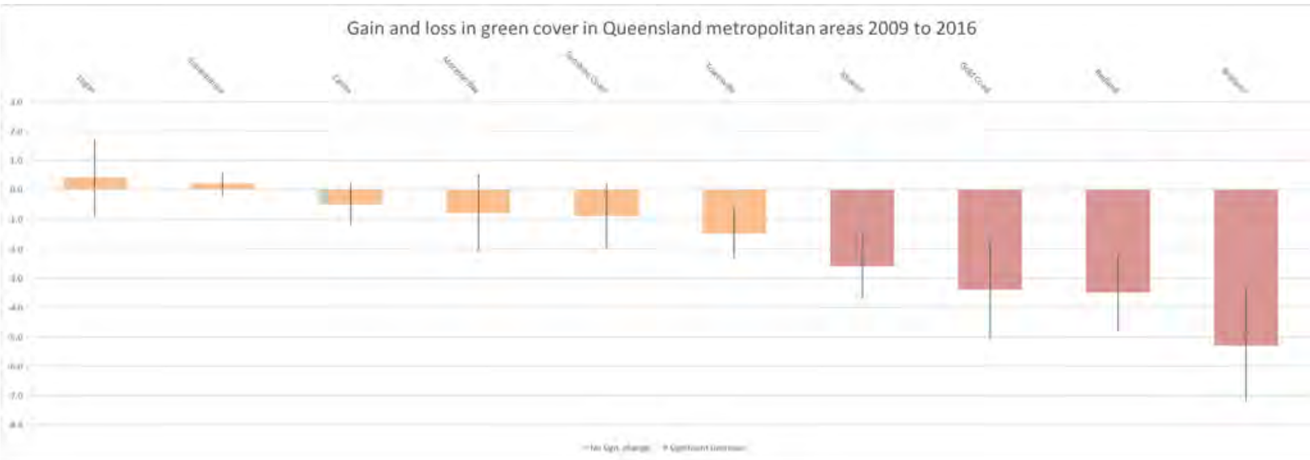

Prepared by Marco Amati

Figure 23: Changes in total green cover for NT 2009-2016



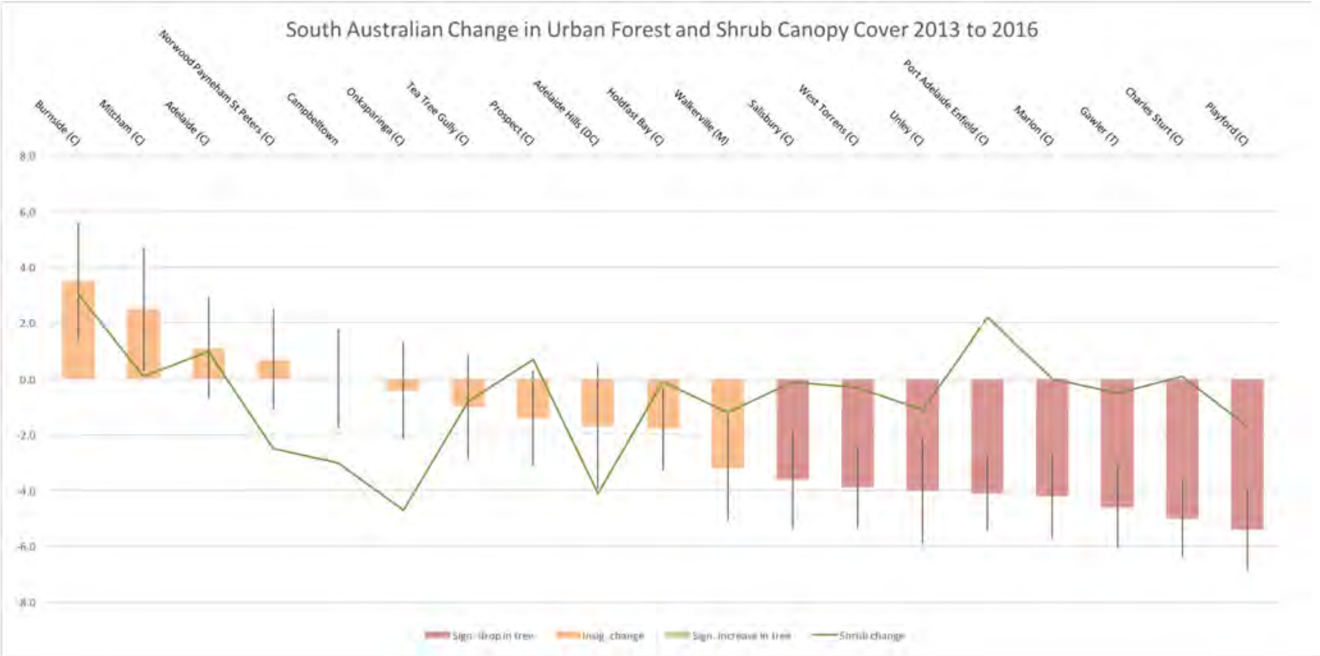

Prepared by Marco Amati

Figure 24: Changes in Canopy and Shrubs for Queensland 2009-2016



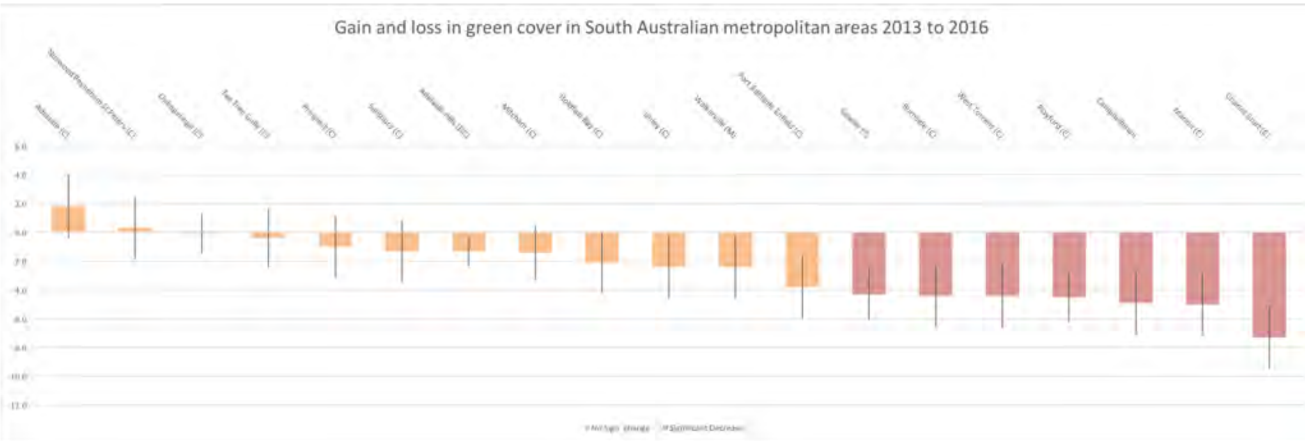

Prepared by Marco Amati

Figure 25: Changes in total green cover for Queensland 2009-2016



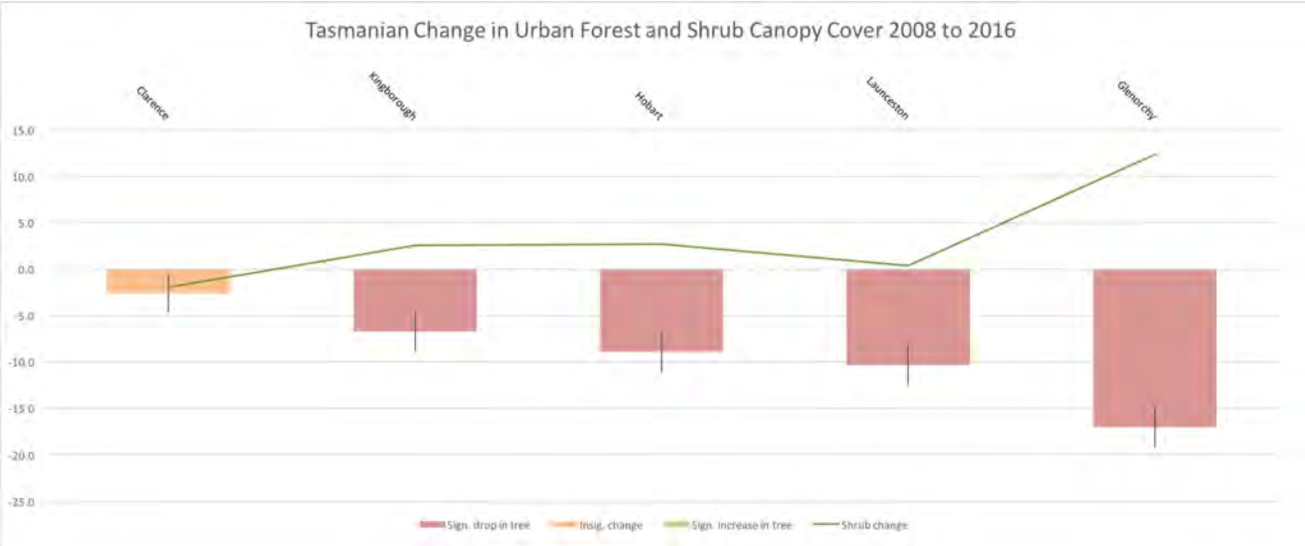

Prepared by Marco Amati

Figure 26: Changes in Canopy and Shrubs for SA 2013-2016



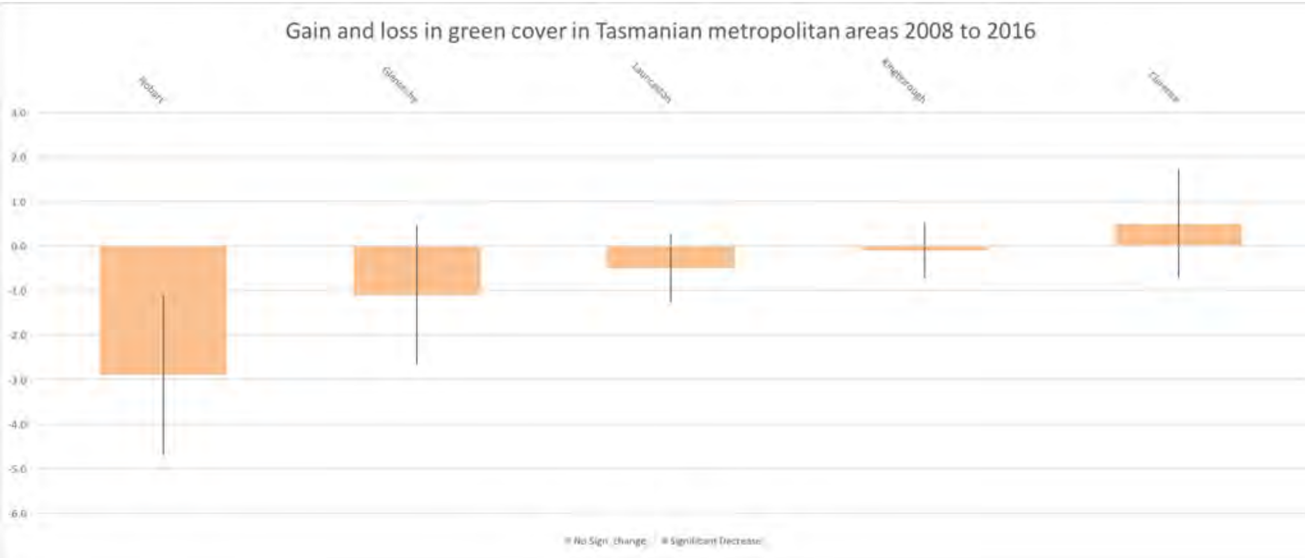

Prepared by Marco Amati

Figure 27: Changes in total green cover for SA 2013-2016



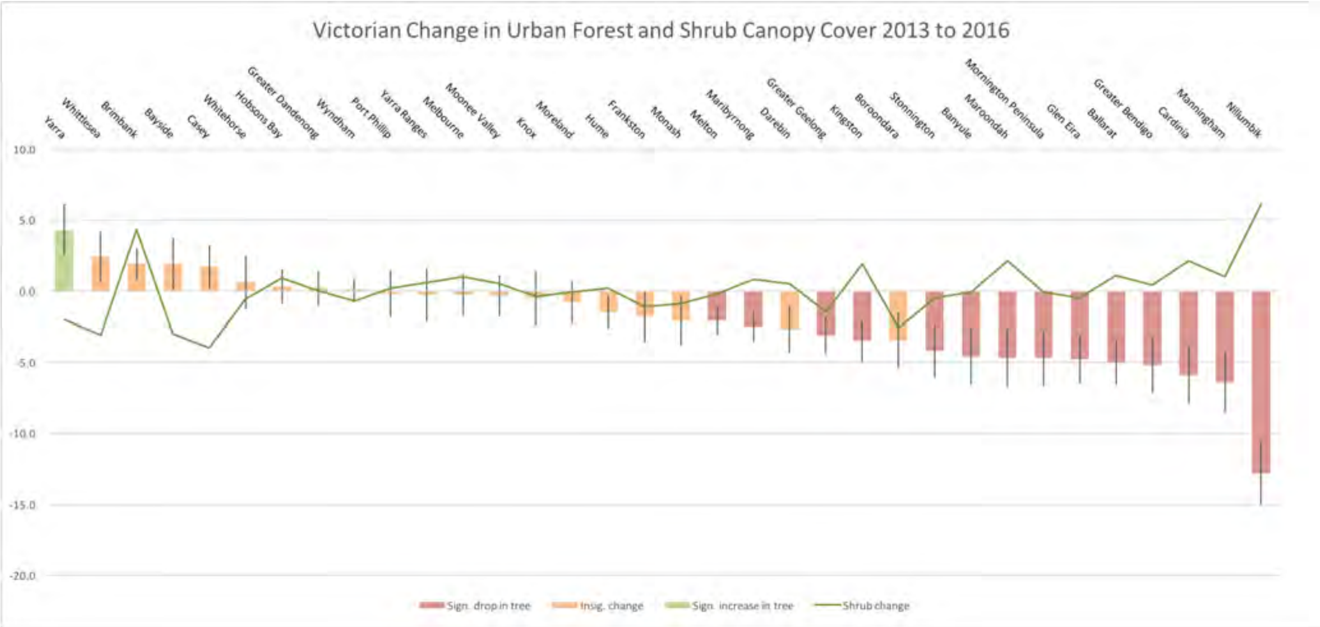

Prepared by Marco Amati

Figure 28: Changes in Canopy and Shrubs for Tasmania 2008-2016



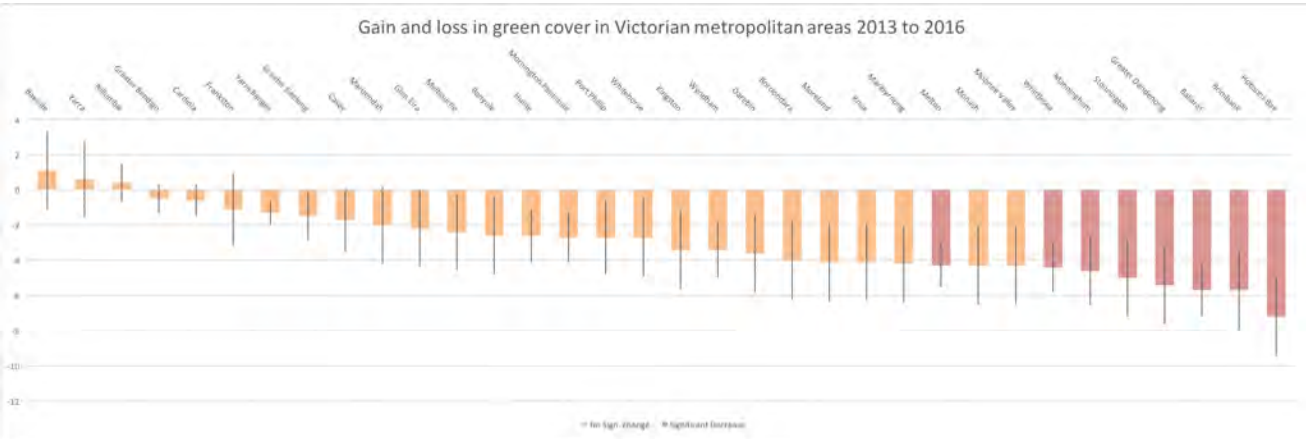

Prepared by Marco Amati

Figure 29: Changes in total green cover for Tasmania 2008-2016



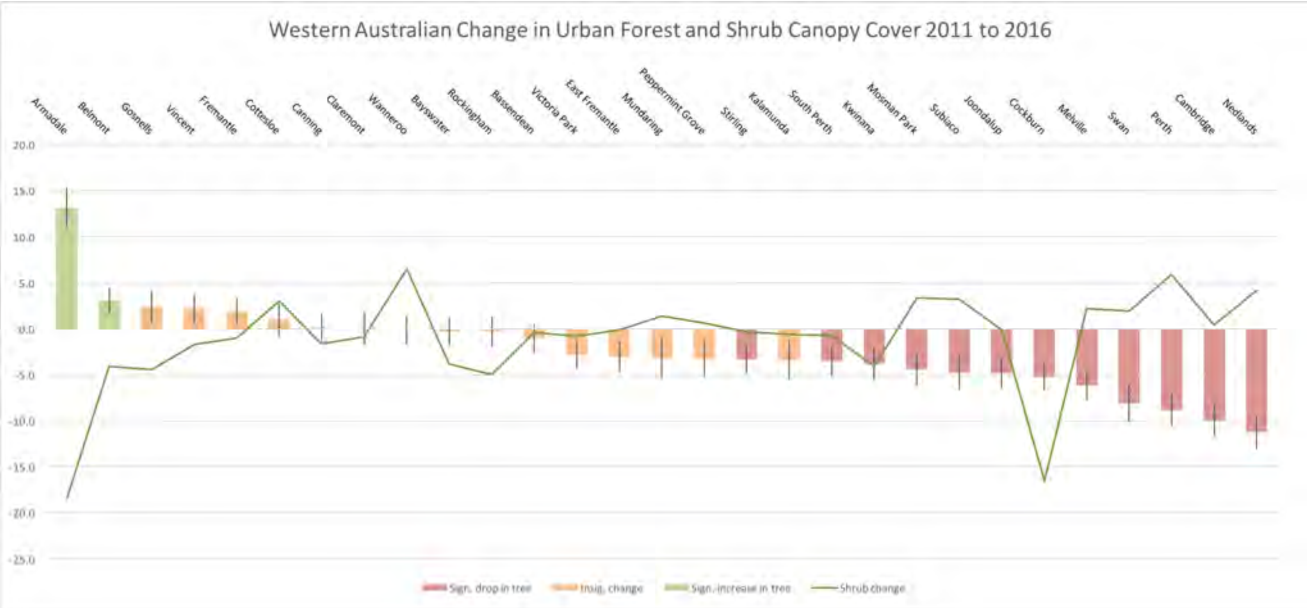

Prepared by Marco Amati

Figure 30: Changes in Canopy and Shrubs for Victoria 2013-2016



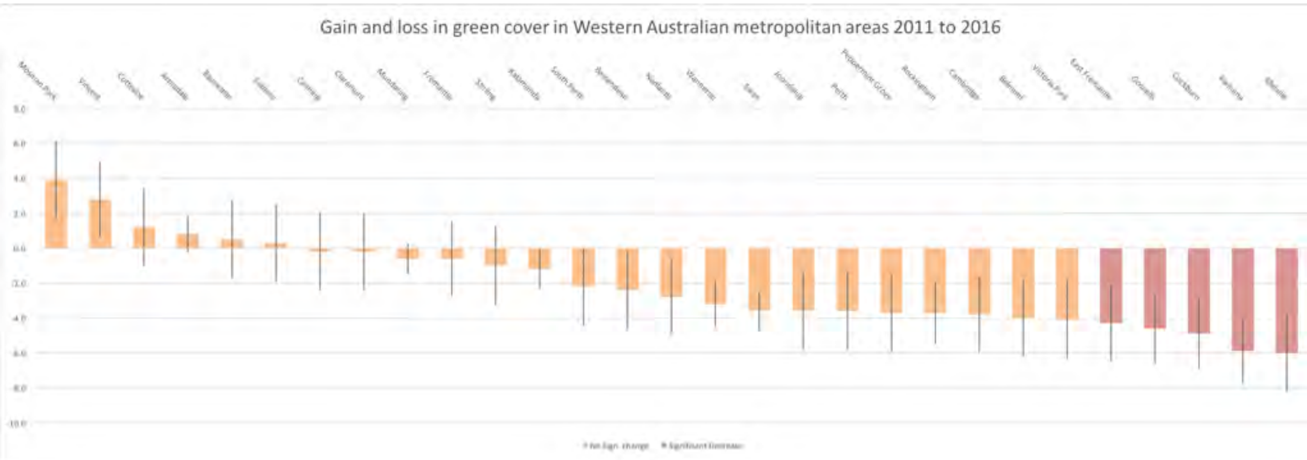

Prepared by Marco Amati

Figure 31: Changes in total green cover for Victoria 2013-2016




Prepared by Marco Amati

Figure 32: Changes in Canopy and Shrubs for WA 2011-2016




Prepared by Marco Amati

Figure 33: Changes in total green cover for WA 2011-2016

# 2 Urban Heat Island Results for Australian Cities

## 2.1 Introduction

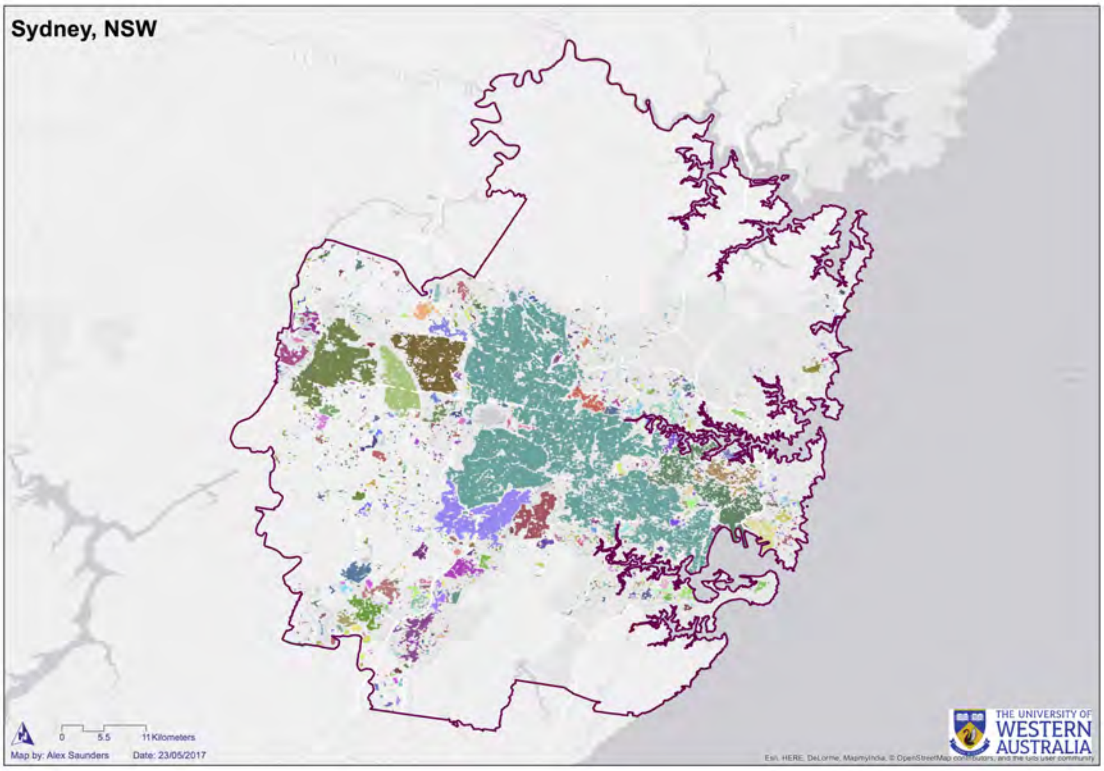
Because of the size of the full set of results from this part of the research (3 sets of 148 maps, total file size 1.5 GB) it was decided to only display a selection of the data for this part of the project.

## 2.2 Metro wide areas of heat

The following includes the maps produced at the metro level with hot spots individually determined at the mean of temperature plus one, two and three standard deviations.

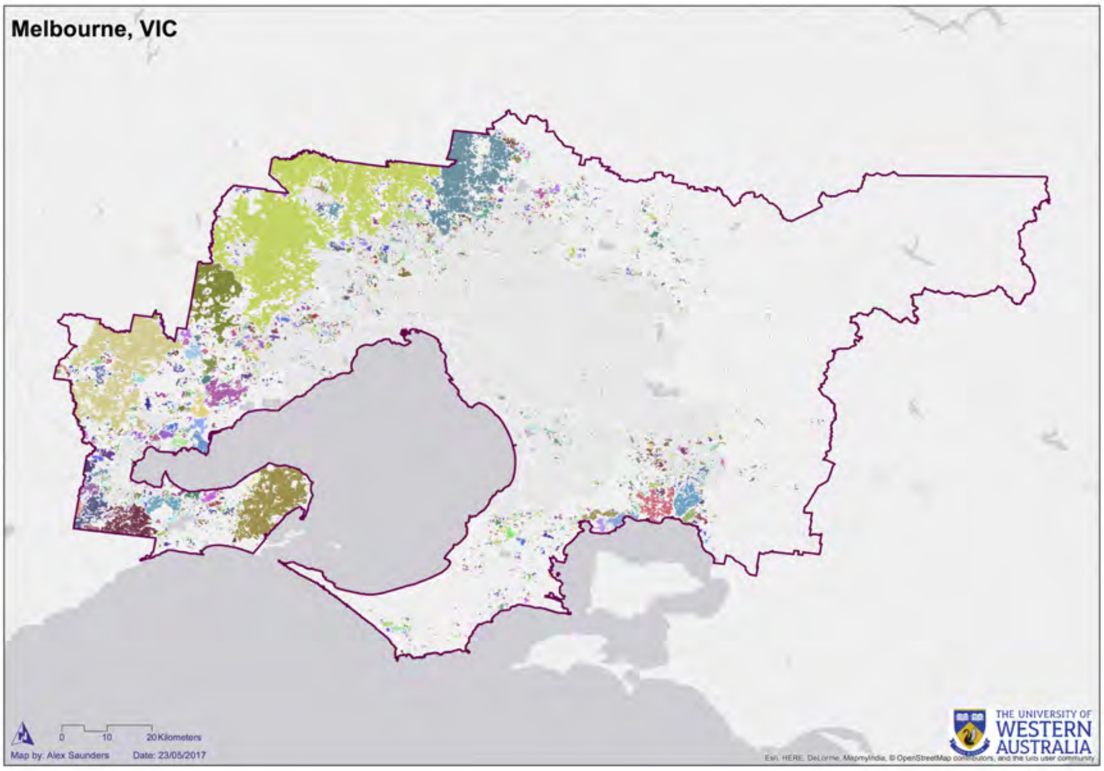
Section 2.4 page 37 shows the maps at State level. Overall some clear trends can be discerned through these.

- *Inside out heat islands* The heat islands for Australian cities is generally lower than that for rural areas. This is because of the latter's inland location and the lack of irrigation on farmland. This is particularly evident in the case of Bendigo and Townsville.
- *A strong link between the affluent areas of towns and a lack of heat* In some of the larger cities such as Melbourne and Sydney, the influence of national parks and also affluence can be seen. Melbourne's areas to the east are generally cooler than those to the West. In Sydney the upper North Shore is cooler compared to areas to the South and West.
- *The impact of infrastructure* Large areas of infrastructure are particularly evident in, Newcastle, Darwin and Sydney for example with the impact of asphalted areas being seen.
- *Heat continents not heat islands* Figure 34 on page 34 and Figure 35 on page 34 shows the lowest temperature for hotspots but coloured by contiguity of heat patches. The maps show that in Australian cities a single patch of heat island (or 'continent') can occupy large areas of the city. These large patches would form a stable area of heat in the city and may resist changes in wind and temperature more than smaller patches. A key task for strategic planning of green infrastructure would be to invest resources in planting corridors to break up these large areas.




Prepared by Alex Saunders. Hot spot defined as 1 standard deviation above the mean.

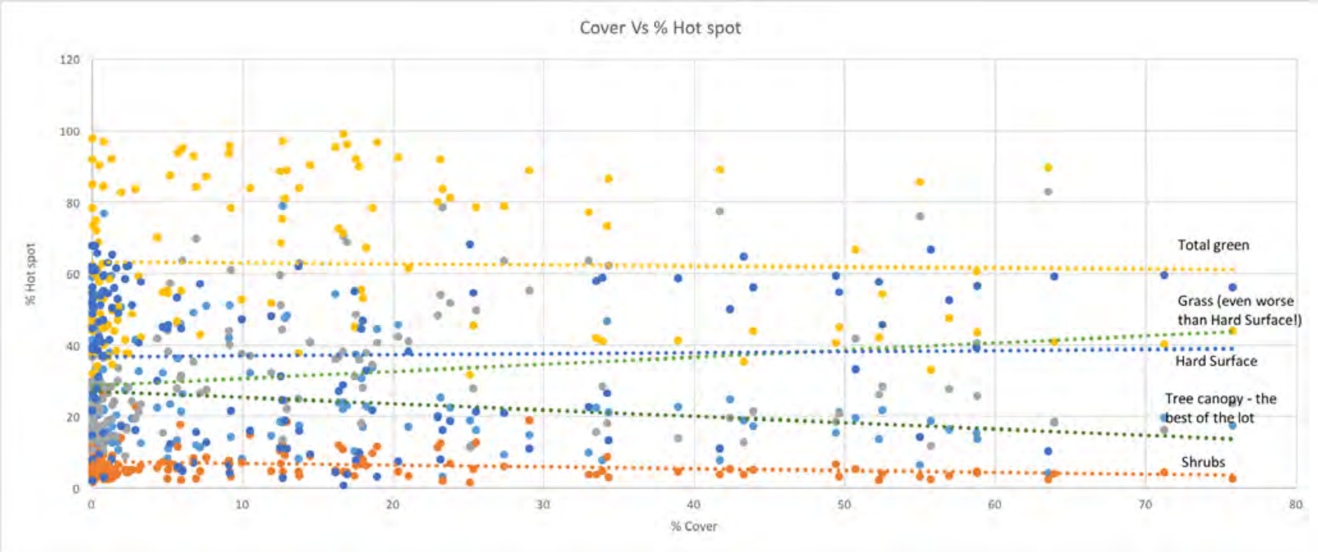
Figure 34: Contiguous areas of Urban Heat Island in Sydney coloured differently for each contiguous area.




Prepared by Alex Saunders. A hot spot is defined as 1 standard deviation above the mean.

Figure 35: Contiguous areas of Urban Heat Island in Melbourne coloured differently for each contiguous area.

Finally, the relationship overall between heat and the different kinds of land cover also bear out these findings. Figure 36 shows that tree canopy has the most significant impact on % hot spot. Shrub and total green have less of an impact. Surprisingly, grass results in an increase in %hot spot. This is possibly due to the inside-out nature of heat islands in Australia with unirrigated pasture resulting in hot areas.




Prepared by Marco Amati

Figure 36: Trendlines displaying the relationship between the different % land covers and % hot spot for each LGA.

## 2.3 LGA level hot spots

For the maps at LGA level (Section 2.5, page 51) different and varied trends are evident compared to the maps at State level. For example the map focused on Strathfield, NSW in inner Sydney displays a variety of features that are commonly borne out in many of the LGA scale maps.

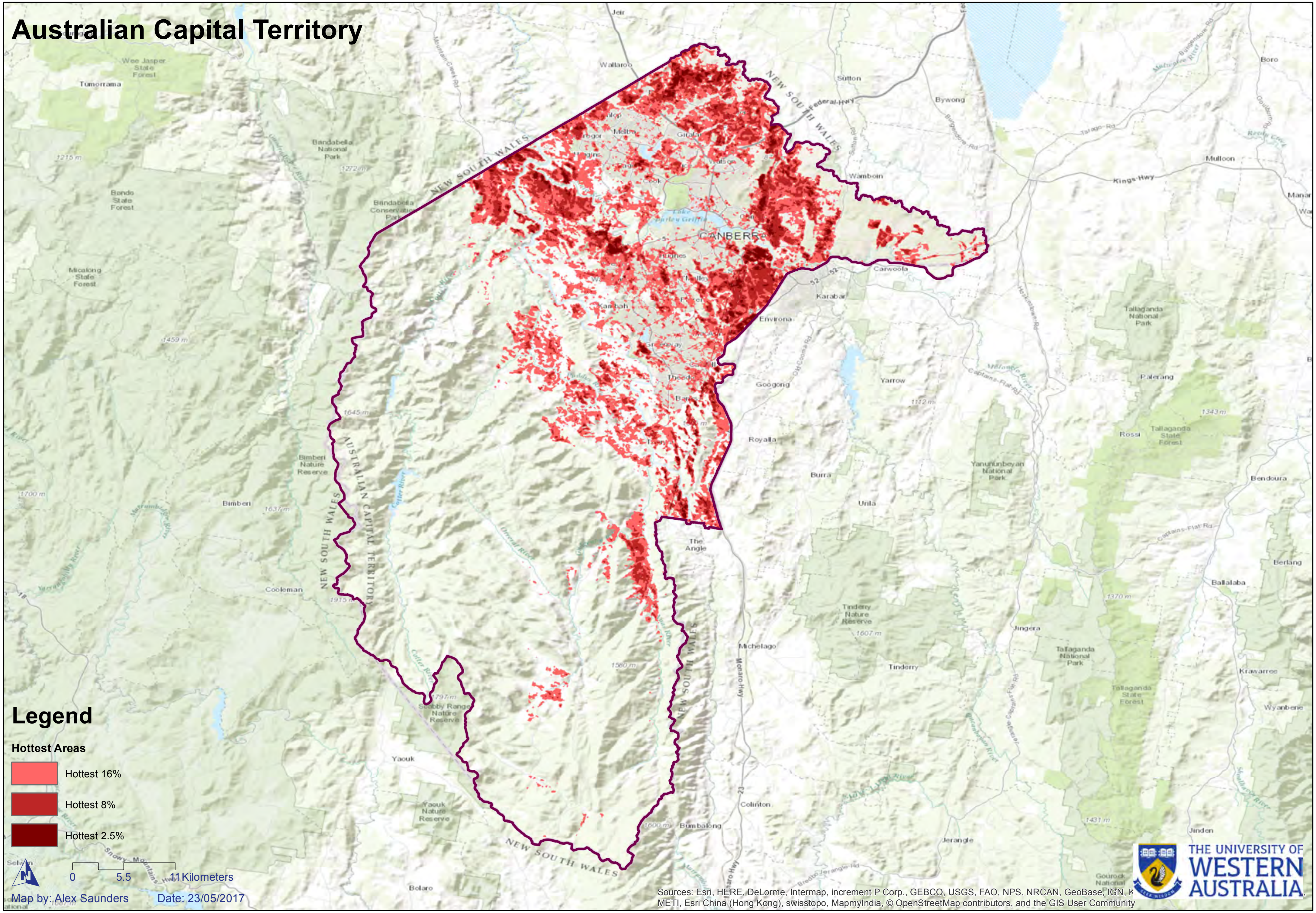
- *The impact of large areas of infrastructure* The maps show the impact of railway yards and certain roofs of warehouses in the inner west. In all cases these hotspots that are more than 13 degrees hotter than equivalent native vegetation have an orbital impact on the surroundings.
- *The important impact of corridors of native bush* Even in this highly urbanised context, the maps show the often assumed but rarely displayed impact of river corridors and areas of green space such as golf courses on the heat patterns.
- *The impact of the coast* Although, obvious, the limited amount of coastline to the north-east in the neighbouring LGA of Canada Bay also shows the cooling ambient effect of the coastline that can have an impact of two or three houses deep.

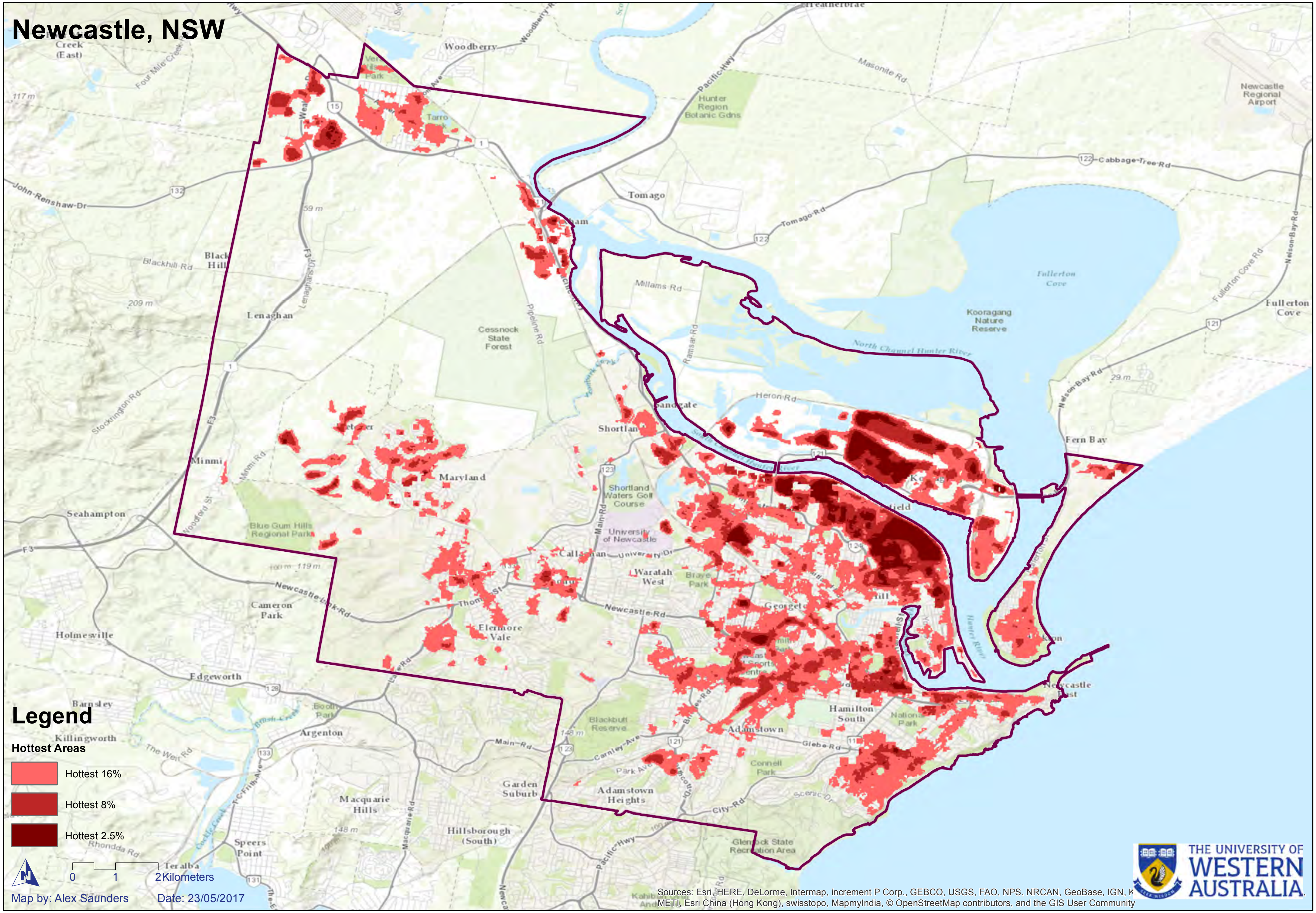
When overlaying the heat maps of LGAs in other areas of Western Sydney the strategic implications of this data become clearer.

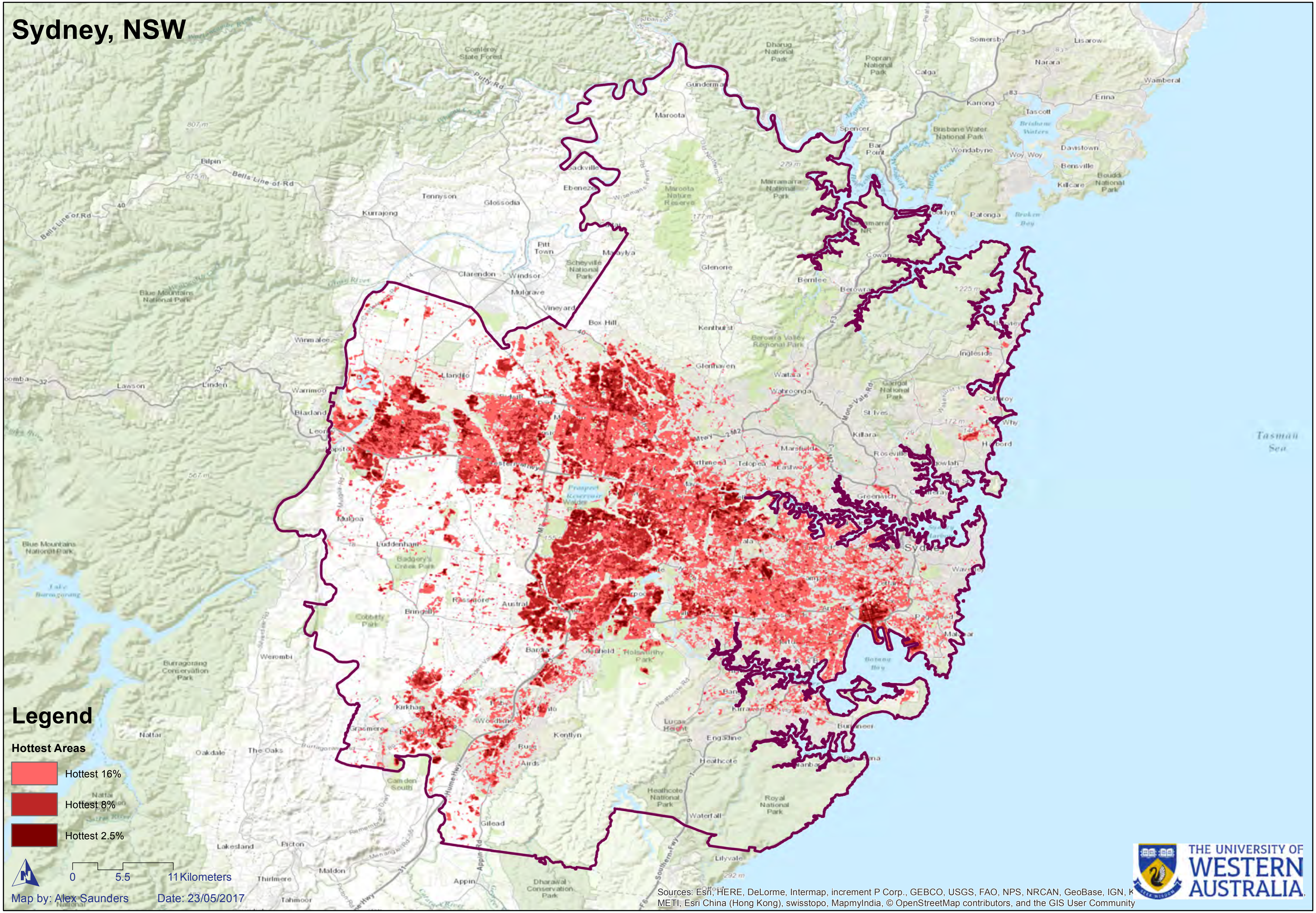
Page 53 shows the map for Fairfield, NSW overlaid on a SEIFA map of Index of Relative Socio-Economic Disadvantage. The area to the East is hotter than the West. A key piece of green infrastructure are the Western Sydney Parklands and the Fairfield Golf Course in the Centre of the urban area. While the area to the East is relatively homogeneous from the point of view of socio-economic disadvantage to the north, in the industrial area extreme hotspots coincide with areas of disadvantage. On the other side of the Western Sydney Parklands to the West, a large area with a lack of socio-economic disadvantage coincides with almost no hotspots. However some extreme patches of heat exist in areas of socio-economic disadvantage.

Section 2.5.3 page 54 shows the same information allowing easy idenfication of the above areas, i.e. Bossley Park around Victoria Street and north Horsley Park.

## 2.4 State based Heat Maps


Australian Capital Territory
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
5.5
11 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
CANBERRA
NEW SOUTH WALES
AUSTRALIAN CAPITAL TERRITORY
Wallaroo
Sutton
Bywong
Wamboin
Carwoola
Karabar
Environa
Googong
Royalla
Burra
Urila
The Angle
Michelago
Tinderry
Colinton
Bumbalong
Yaouk
Bolaro
Bimberi
Cooleman
Tumorrama
Kings Hwy
Federal Hwy
Monaro Hwy
Mulloon
Boro
Palerang
Rossi
Bendoura
Berlang
Ballalaba
Jingera
Krawarree
Wyanbene
Jinden
Jerangle
Tallaganda National Park
Tallaganda State Forest
Yanununbeyan National Park
Tinderry Nature Reserve
Bimberi Nature Reserve
Brindabella National Park
Bondo State Forest
Micalong State Forest
Wee Jasper State Forest
Scabby Range Nature Reserve
Yaouk Nature Reserve


Newcastle, NSW
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
1
2 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
Tomago
Kooragang Nature Reserve
Fullerton Cove
North Channel Hunter River
Newcastle Regional Airport
Hunter Region Botanic Gdns
Cessnock State Forest
Lenaghan
Minmi
Seahampton
Blue Gum Hills Regional Park
Maryland
Shortland
Shortland Waters Golf Course
University of Newcastle
Waratah West
Cameron Park
Holmesville
Elermore Vale
Edgeworth
Barnsley
Killingworth
Argenton
Blackbutt Reserve
Adamstown
Hamilton South
National Park
Connell Park
Garden Suburb
Macquarie Hills
Adamstown Heights
Hillsborough (South)
Speers Point
Teralba
Woodberry
Fern Bay
Fullerton Cove
Black Hill
Newcastle-Link-Rd
Newcastle-Rd
Cabbage-Tree-Rd
John-Renshaw-Dr
Blackhill-Rd
Tomago-Rd
Nelson-Bay-Rd
Heron-Rd
Millams-Rd
Pacific-Hwy


Sydney, NSW
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
N
0
5.5
11 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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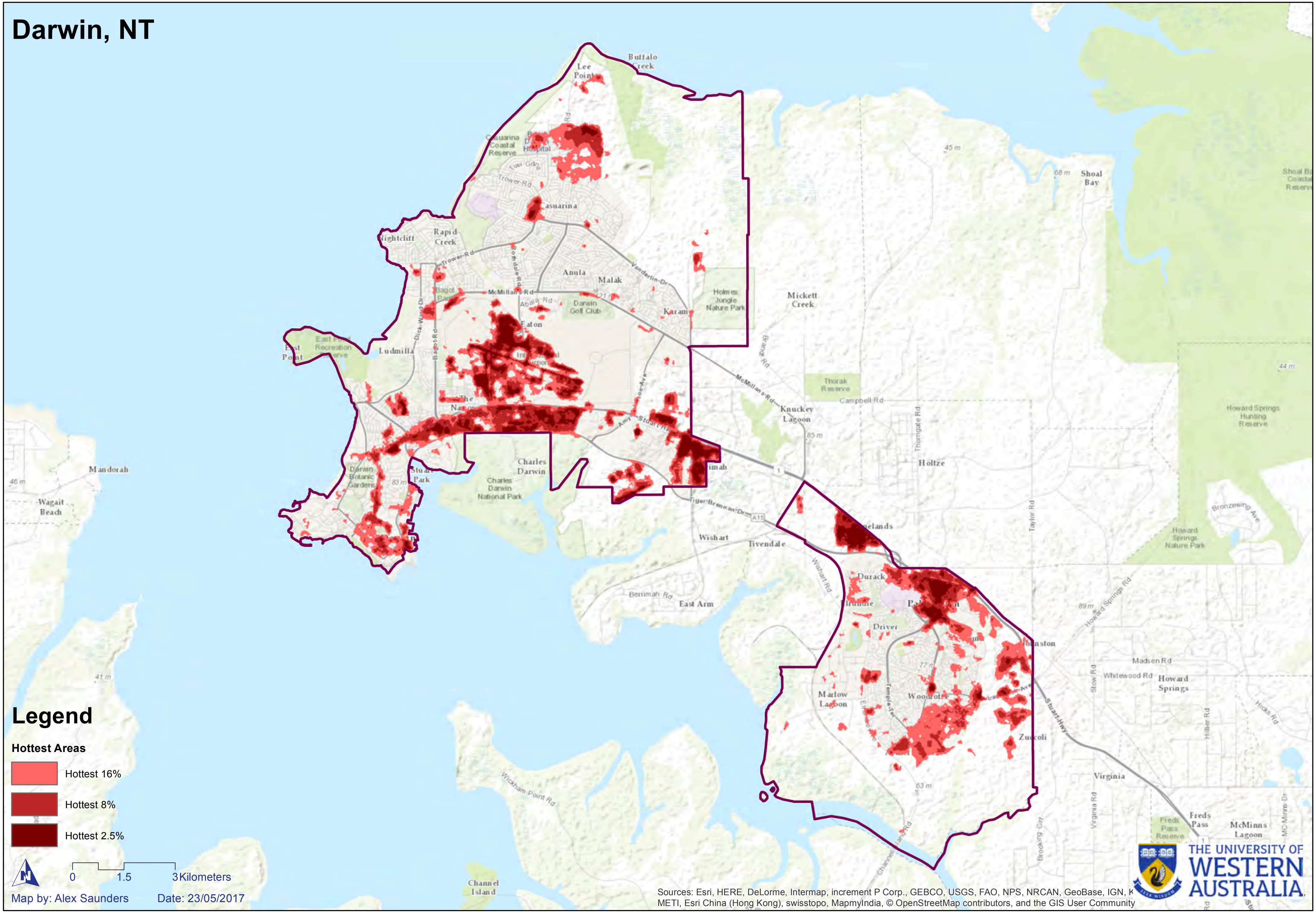
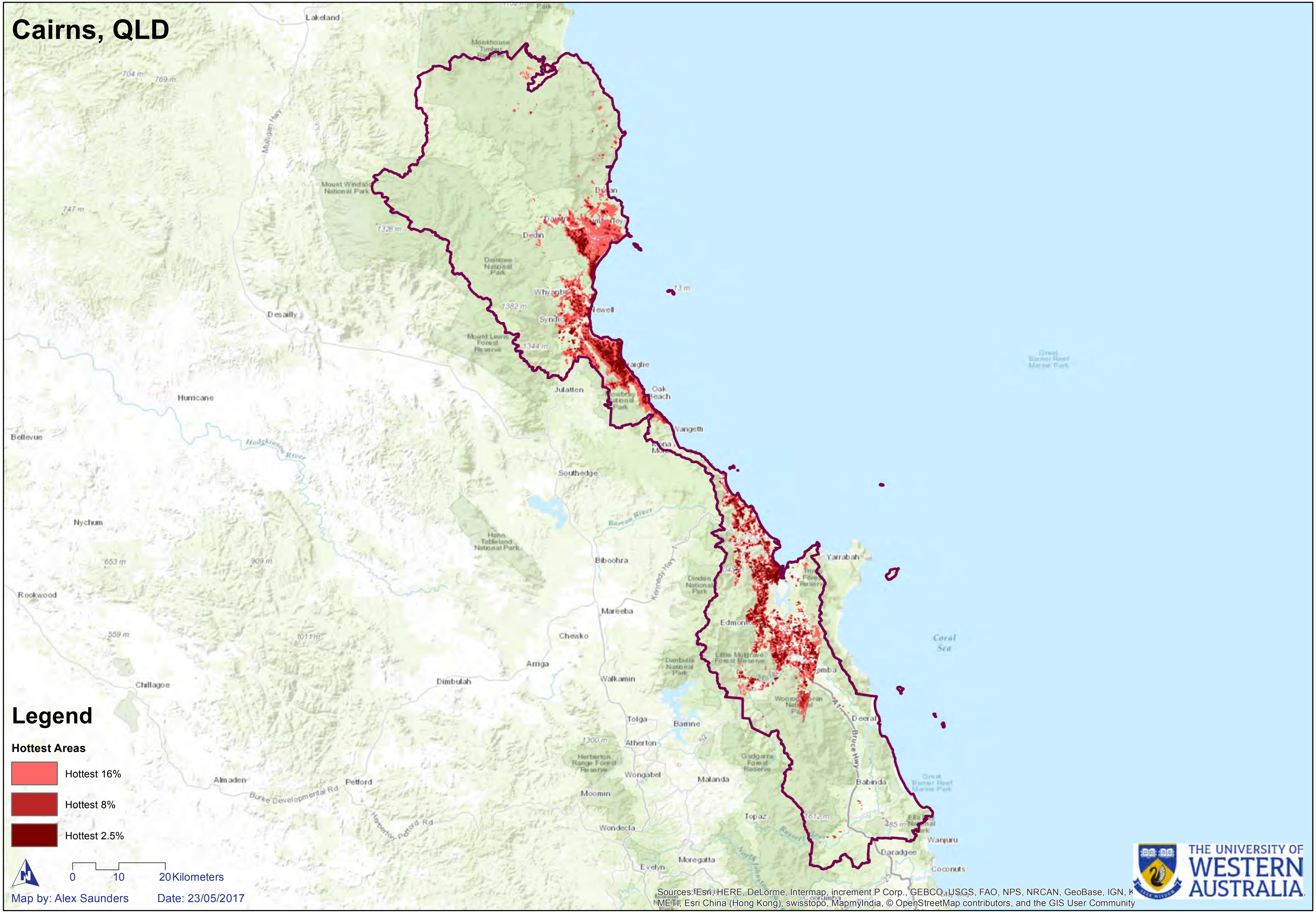
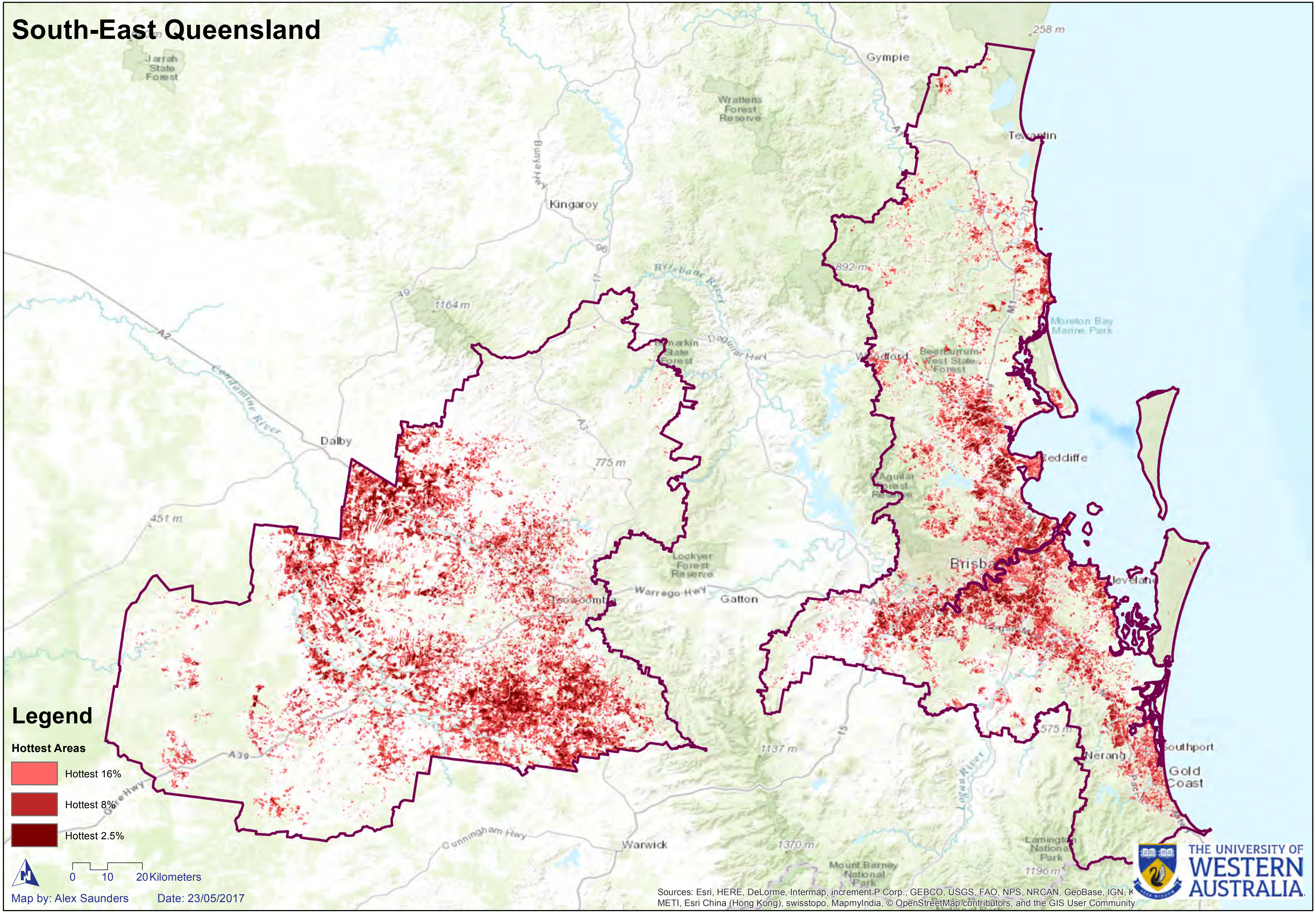
Tasman Sea
Sydney


Darwin, NT
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
1.5
3 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
Buffalo Creek
Lee Point
Casuarina
Rapid Creek
Nightcliff
Anula
Malak
Karama
Ludmilla
Eaton
Mickett Creek
Holmes Jungle Nature Park
Knuckey Lagoon
Holtze
Charles Darwin
Charles Darwin National Park
Mandorah
Wagait Beach
Wishart
Tivendale
Durack
Driver
Marlow Lagoon
Zuccoli
Howard Springs
Virginia
Shoal Bay
East Arm
Channel Island
Freds Pass
McMinns Lagoon



Cairns, QLD
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
10
20 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
Lakeland
Hurricane
Bellevue
Nychum
Rookwood
Chillagoe
Almaden
Petford
Dimbulah
Arriga
Chewko
Mareeba
Biboohra
Julatten
Southedge
Desailly
Walkamin
Tolga
Atherton
Barrine
Wongabel
Malanda
Moomin
Wondecla
Topaz
Evelyn
Moregatta
Yarrabah
Deeral
Babinda
Wanjuru
Daradgee
Coconuts
Edmonton
Whyanbeel
Newell
Wangetti
Oak Beach
Dedin
Syndicate
Coral Sea
Burke Development Rd
Bruce Hwy
Mulligan Hwy
Kennedy Hwy
Hodgkinson River
Barron River
Daintree National Park
Mount Windsor National Park
Mount Lewis Forest Reserve
Hann Tableland National Park
Dinden National Park
Danbulla National Park
Herberton Range Forest Reserve
Gadgarra Forest Reserve
Little Mulgrave Forest Reserve
Great Barrier Reef Marine Park
704 m
769 m
747 m
1328 m
1382 m
1344 m
653 m
909 m
559 m
1011 m
1300 m
1612 m
485 m
13 m


South-East Queensland
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0 10 20 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
THE UNIVERSITY OF WESTERN AUSTRALIA
Gympie
Kingaroy
Dalby
Toowoomba
Gatton
Warwick
Woodford
Redcliffe
Cleveland
Southport
Gold Coast
Nerang
Jarrah State Forest
Wrattens Forest Reserve
Lockyer Forest Reserve
Moreton Bay Marine Park
Mount Barney National Park
Warrego Hwy
Cunningham Hwy
Condamine River
Brisbane River
258 m
892 m
1164 m
775 m
451 m
1137 m
1370 m
575 m
1196 m
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
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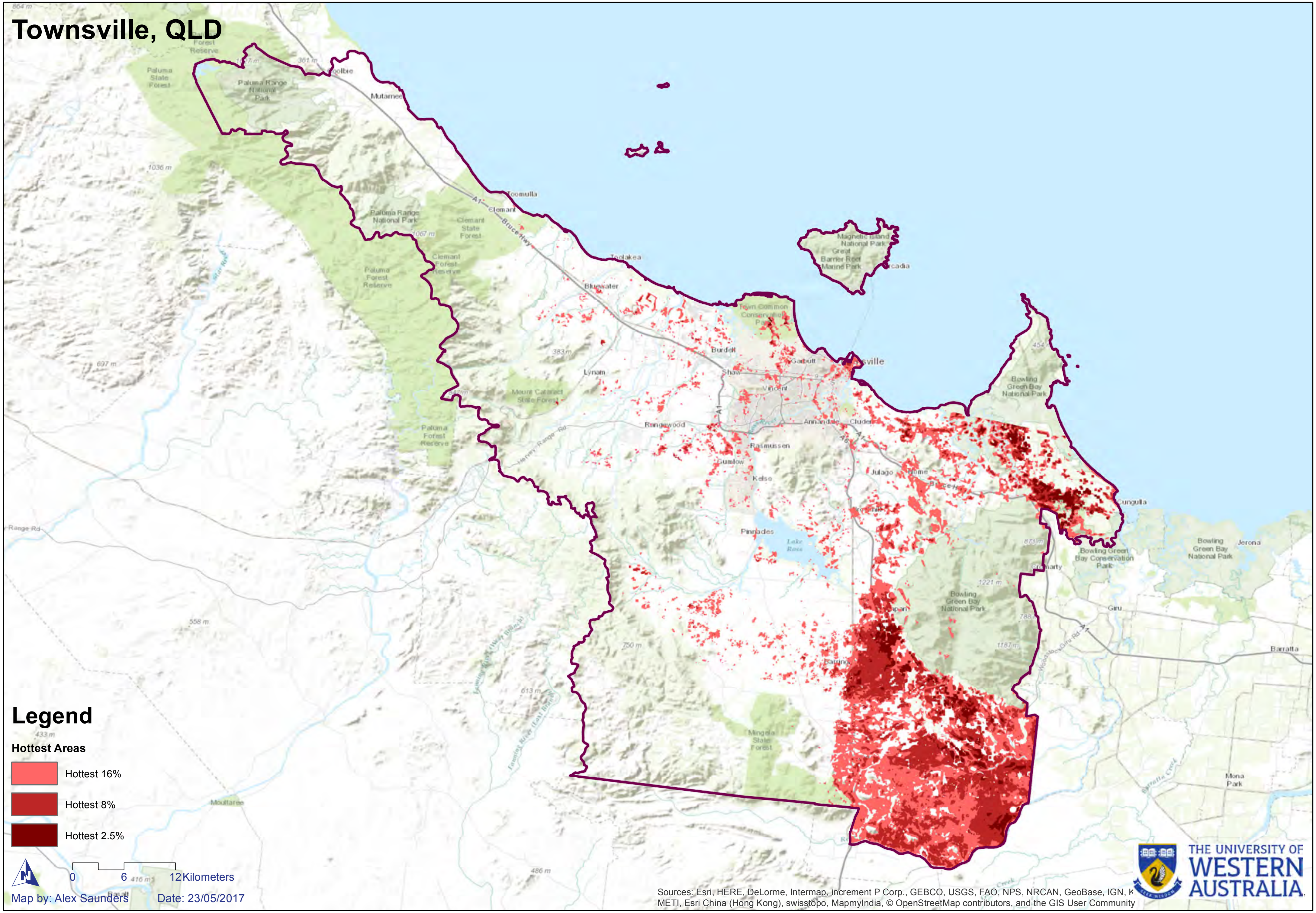
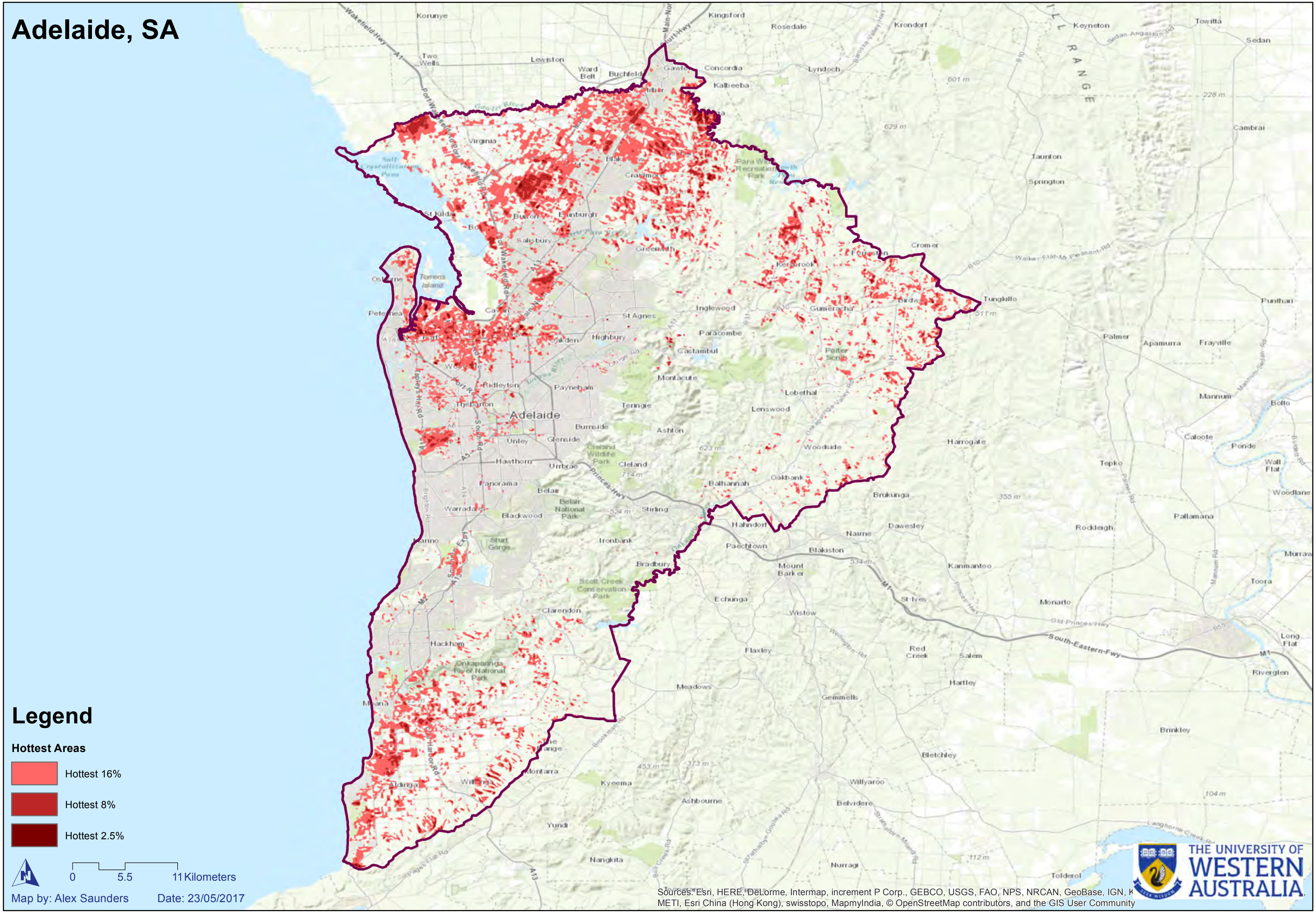

Townsville, QLD
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
6
12Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF
WESTERN
AUSTRALIA
Paluma State Forest
Paluma Range National Park
Mutarnee
Toomulla
Clemant
Paluma Range National Park
Clemant State Forest
Clemant State Forest Reserve
Paluma Forest Reserve
Toolakea
Bluewater
Burdell
Lynam
Mount Cataract State Forest
Shaw
Garbutt
Vincent
Rangewood
Annandale
Cluden
Rasmussen
Gumlow
Kelso
Julago
Pinnacles
Lake Ross
Magnetic Island National Park
Great Barrier Reef Marine Park
Arcadia
Town Common Conservation Park
Bowling Green Bay National Park
Cungulla
Bowling Green Bay Conservation Park
Bowling Green Bay National Park
Jerona
Giru
Barratta
Mingela State Forest
Mona Park
Moultaree
Paluma Forest Reserve
Bruce Hwy
Hervey Range Rd



Adelaide, SA
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0 5.5 11 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
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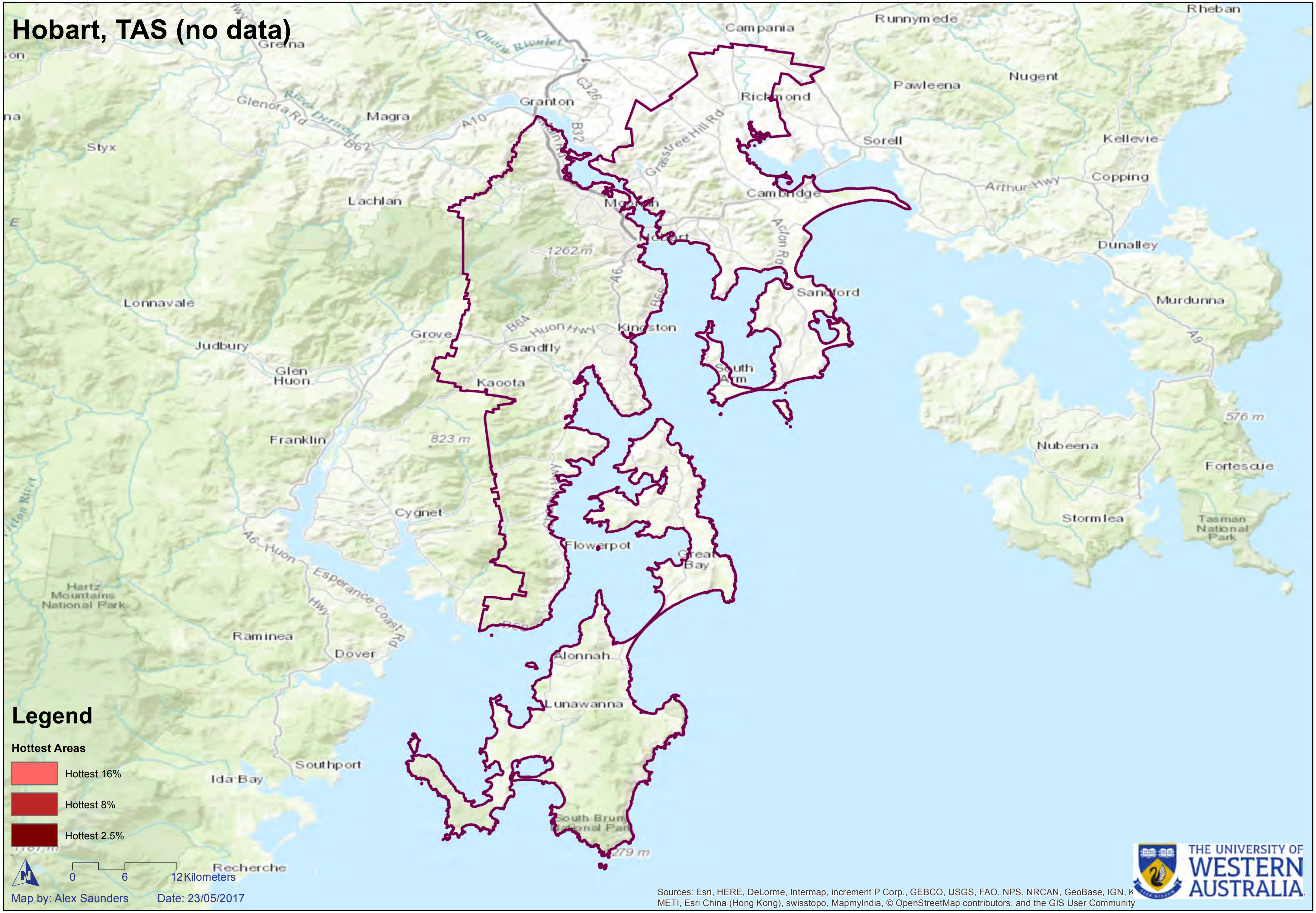
THE UNIVERSITY OF WESTERN AUSTRALIA
Adelaide
Korunye
Kingsford
Rosedale
Krondorf
Keyneton
Towitta
Sedan
Two Wells
Lewiston
Ward Belt
Buchfield
Concordia
Lyndoch
Kalbeeba
Cambrai
Virginia
Taunton
Springton
St Kilda
Salisbury
Greenwith
Cromer
Torrens Island
Tungkillo
Punthari
Inglewood
Gumeracha
St Agnes
Highbury
Paracombe
Palmer
Apamurra
Frayville
Montacute
Lobethal
Paynehem
Ridleyton
Thebarton
Teringie
Lenswood
Mannum
Bolto
Burnside
Ashton
Glenside
Unley
Woodside
Harrogate
Caloote
Ponde
Hawthorn
Urrbrae
Cleland
Oakbank
Tepko
Panorama
Balhannah
Brukunga
Belair
Warradale
Blackwood
Stirling
Hahndorf
Nairne
Dawesley
Rockleigh
Pallamana
Woodlane
Paechtown
Blakiston
Mount Barker
Kanmantoo
Ironbank
Bradbury
Echunga
St Ives
Monarto
Toora
Clarendon
Wistow
Hackham
Flaxley
Red Creek
Salem
Long Flat
Riverglen
Meadows
Hartley
Gemmells
Brinkley
Montarra
Kyeema
Bletchley
Aldinga
Willyaroo
Ashbourne
Belvidere
Yundi
Nangkita
Nurragi
Tolderol
South-Eastern-Fwy
Princes-Hwy



Hobart, TAS (no data)
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
6
12 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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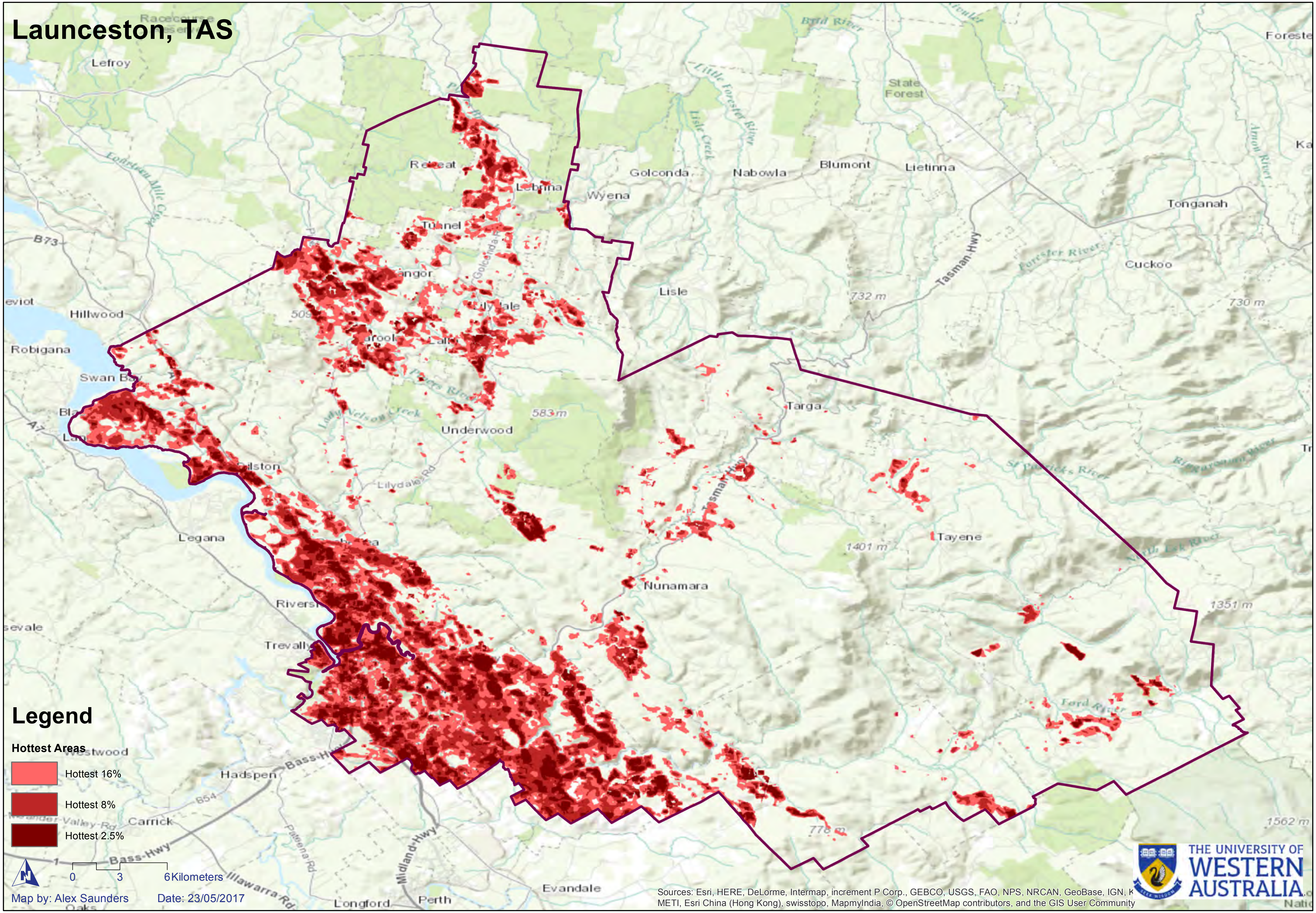
Campania
Runnymede
Rheban
Richmond
Pawleena
Nugent
Granton
Magra
Styx
Sorell
Kellevie
Copping
Cambridge
Arthur Hwy
Lachlan
Dunalley
Sandford
Murdunna
Lonnavale
Grove
Kingston
Judbury
Sandfly
Glen Huon
Kaoota
South Arm
Franklin
Nubeena
Fortescue
Cygnet
Stormlea
Tasman National Park
Flowerpot
Great Bay
Hartz Mountains National Park
Raminea
Dover
Alonnah
Lunawanna
Southport
Ida Bay
Recherche
South Bruny National Park


Launceston, TAS
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
3
6Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
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THE UNIVERSITY OF
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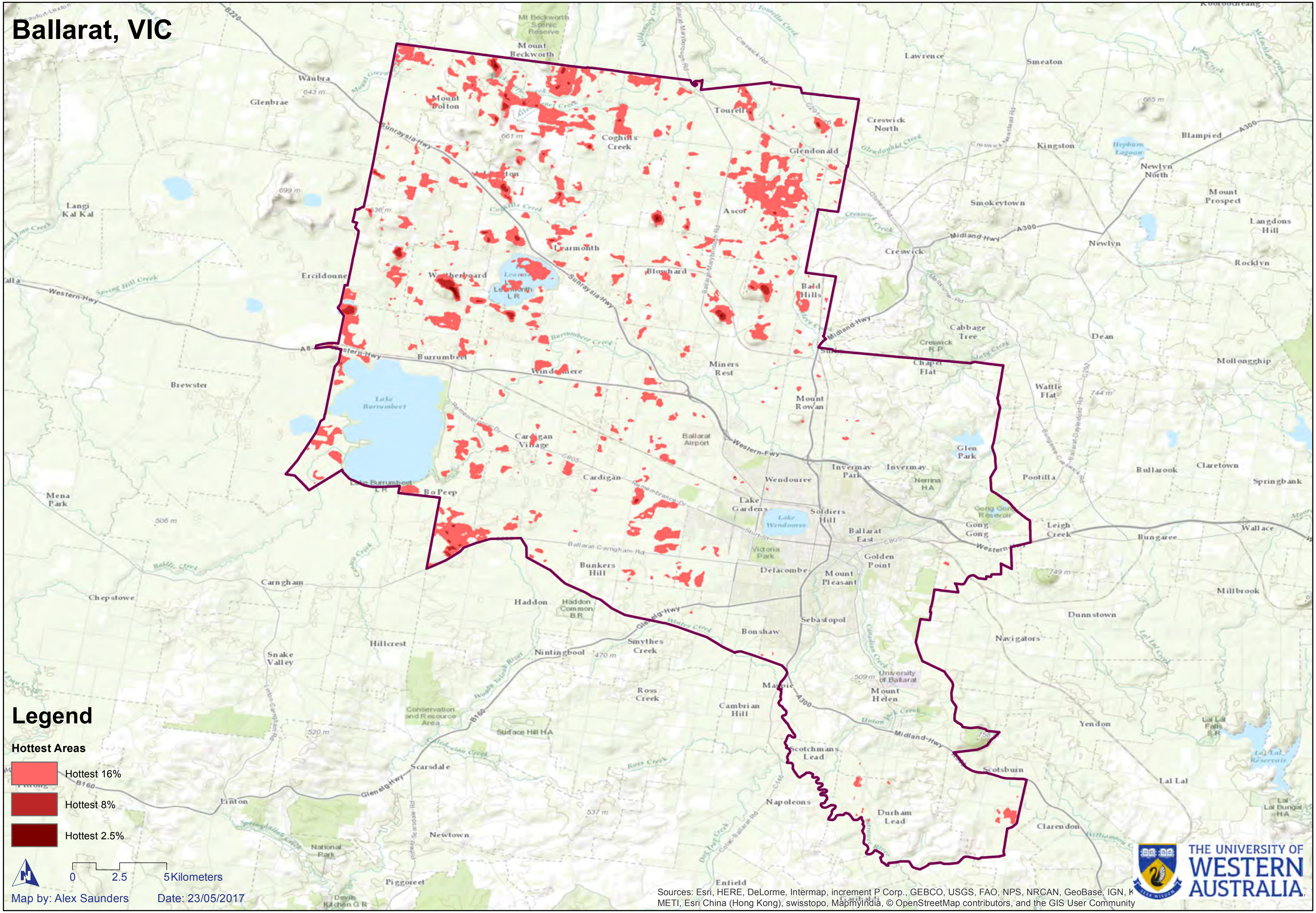
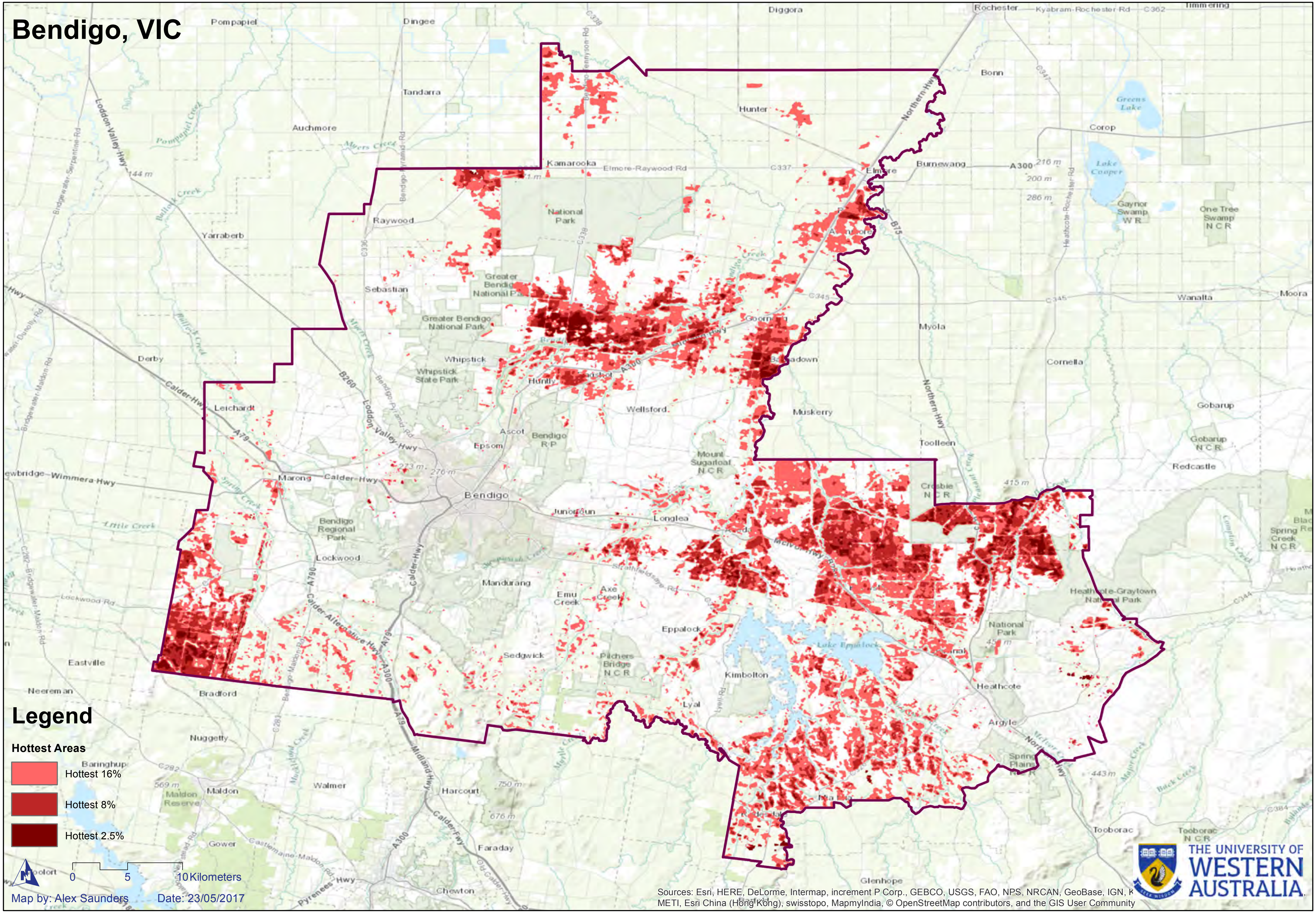
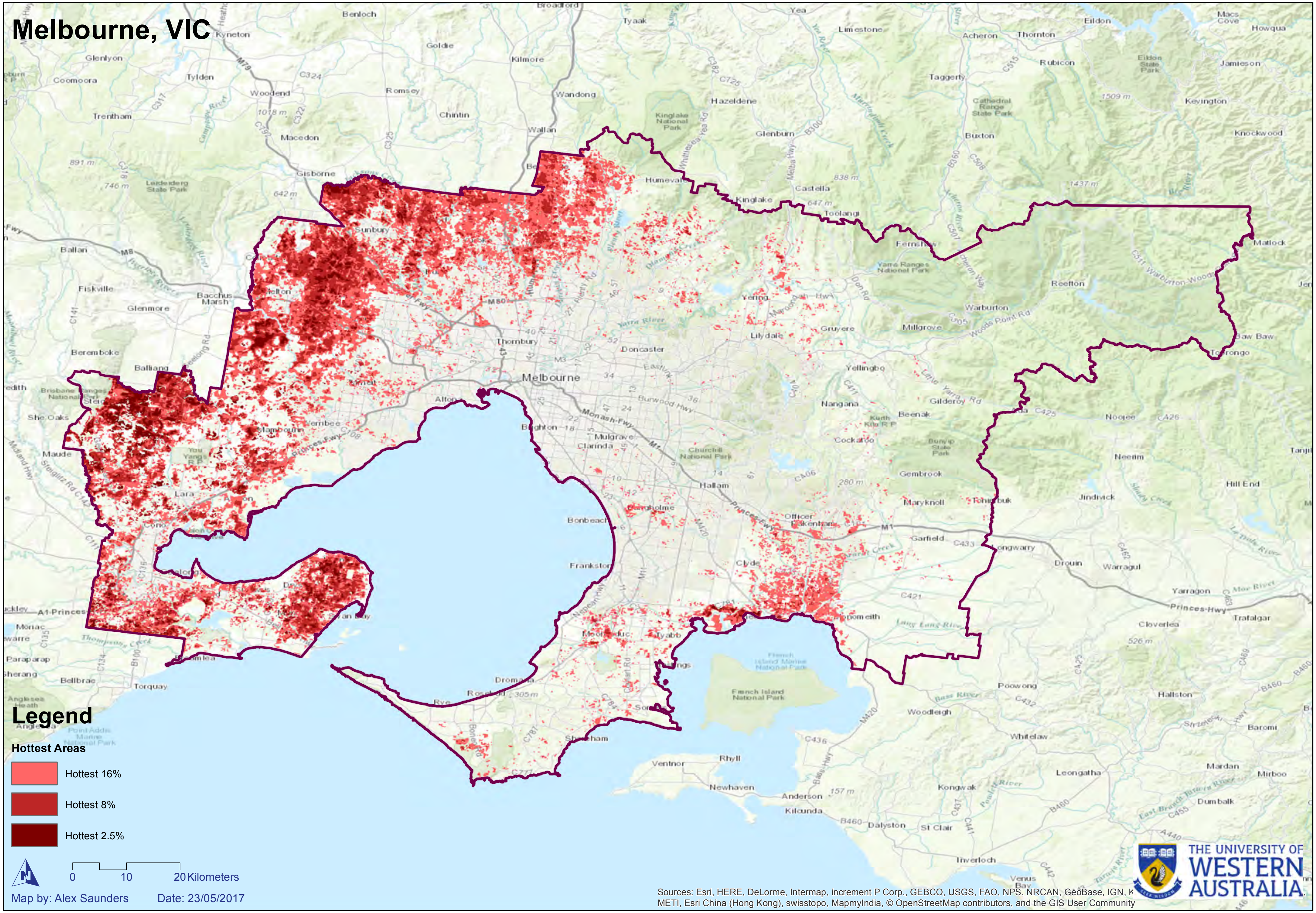
AUSTRALIA
Lefroy
Hillwood
Robigana
Legana
Hadspen
Carrick
Longford
Perth
Evandale
Underwood
Nunamara
Targa
Tayene
Lisle
Golconda
Nabowla
Blumont
Lietinna
Wyena
Tonganah
Cuckoo
State Forest
Tasman Hwy
Midland Hwy
Bass Hwy
Lilydale Rd
Forester River
Ford River
583 m
732 m
730 m
1401 m
1351 m
1562 m

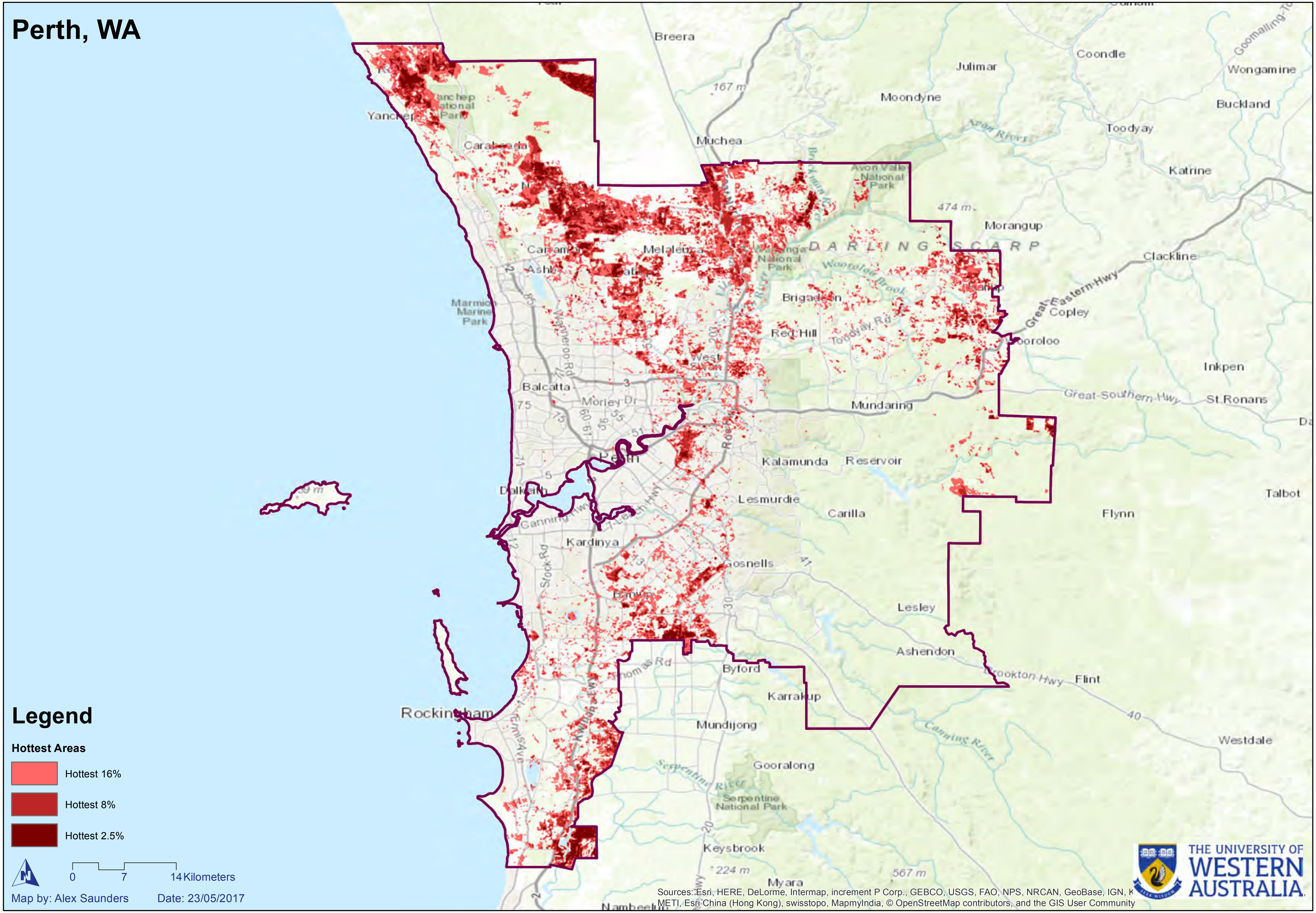


Ballarat, VIC
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0 2.5 5Kilometers
Map by: Alex Saunders
Date: 23/05/2017
THE UNIVERSITY OF WESTERN AUSTRALIA
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Waubra
Glenbrae
Mount Bolton
Coghills Creek
Tourello
Glendonald
Creswick North
Lawrence
Smeaton
Kingston
Ascot
Learmonth
Blowhard
Weatherboard
Bald Hills
Creswick
Smokeytown
Newlyn
Newlyn North
Blampied
Mount Prospect
Langi Kal Kal
Ercildoune
Burrumbeet
Windermere
Miners Rest
Mount Rowan
Brewster
Lake Burrumbeet
Cardigan Village
Cardigan
Ballarat Airport
Wendouree
Invermay Park
Invermay
Glen Park
Lake Gardens
Soldiers Hill
Ballarat East
Golden Point
Bo Peep
Bunkers Hill
Delacombe
Mount Pleasant
Haddon
Carngham
Chepstowe
Mena Park
Sebastopol
Bonshaw
Smythes Creek
Ross Creek
Magpie
Cambrian Hill
Mount Helen
Scotchmans Lead
Durham Lead
Napoleons
Scotsburn
Navigators
Dunnstown
Bullarook
Claretown
Springbank
Leigh Creek
Bungaree
Wallace
Millbrook
Yendon
Lal Lal
Clarendon
Enfield
Piggoreet
Newtown
Linton
Scarsdale
Hillcrest
Snake Valley
Nintingbool
Dean
Mollongghip
Wattle Flat
Pootilla
Cabbage Tree
Chapel Flat
Gong Gong
Rocklyn
Langdons Hill
Western-Hwy
Sunraysia-Hwy
Midland-Hwy
Glenelg-Hwy



Bendigo, VIC
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0 5 10 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
Bendigo
Marong
Junortoun
Longlea
Huntly
Epsom
Ascot
Goornong
Elmore
Kamarooka
Raywood
Sebastian
Leichardt
Lockwood
Mandurang
Sedgwick
Eppalock
Kimbolton
Heathcote
Axedale
Wellsford
Muskerry
Myola
Toolleen
Emu Creek
Lake Eppalock
Harcourt
Maldon
Bradford
Eastville
Nuggetty
Rochester
Diggora
Dingee
Pompapiel
Tandarra
Auchmore
Yarraberb
Derby
Hunter
Bonn
Corop
Burnewang
Wanalta
Moora
Cornella
Gobarup
Redcastle
Argyle
Lyal
Walmer
Faraday
Glenhope
Tooborac
Chewton
Gower
Neereman


Melbourne, VIC
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
10
20 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
THE UNIVERSITY OF WESTERN AUSTRALIA
Melbourne
Sunbury
Thornbury
Doncaster
Werribee
Lara
Frankston
Bonbeach
Dromana
Torquay
Yarra Glen
Lilydale
Warburton
Pakenham
Cranbourne
Hallam
Drouin
Warragul
Yarragon
Kilmore
Wallan
Gisborne
Macedon
Romsey
Kinglake
Bacchus Marsh
Ballan
Leongatha


Perth, WA
Legend
Hottest Areas
Hottest 16%
Hottest 8%
Hottest 2.5%
0
7
14 Kilometers
Map by: Alex Saunders
Date: 23/05/2017
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, K
METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Breera
Julimar
Coondle
Wongamine
Moondyne
Buckland
Toodyay
Muchea
Katrine
Avon Valley National Park
Morangup
DARLING SCARP
Clackline
Great Eastern Hwy
Copley
Brigadoon
Red Hill
Toodyay Rd
Inkpen
Great Southern Hwy
St.Ronans
Mundaring
Balcatta
Morley Dr
Perth
Kalamunda
Reservoir
Lesmurdie
Carilla
Talbot
Flynn
Kardinya
Gosnells
Lesley
Ashendon
Byford
Brookton Hwy
Flint
Karrakup
Rockingham
Mundijong
Westdale
Gooralong
Serpentine National Park
Keysbrook
Myara
Marmion Marine Park
Melaleuca
Wanneroo Rd
Canning Hwy
Stock Rd
Kwinana Fwy
Thomas Rd
Ennis Ave
Serpentine River
Canning River
Avon River

## 2.5 LGA based Heat Maps


# Legend

## Strathfield
## New South Wales

**Key Statistics**

| | |
|---|---|
| **Tree Cover:** | **15.4%** |
| **Change in Proportion:** | **-3%** |
| **Shrub Cover:** | **6.7%** |
| **Change in Proportion:** | **3.2%** |
| **Grass Cover:** | **18.5%** |
| **Change in Proportion:** | **-6.8%** |
| **Hard Surface Cover:** | **59.4%** |
| **Change in Proportion:** | **6.6%** |
| **Hot Spots:** | **49.4%** |

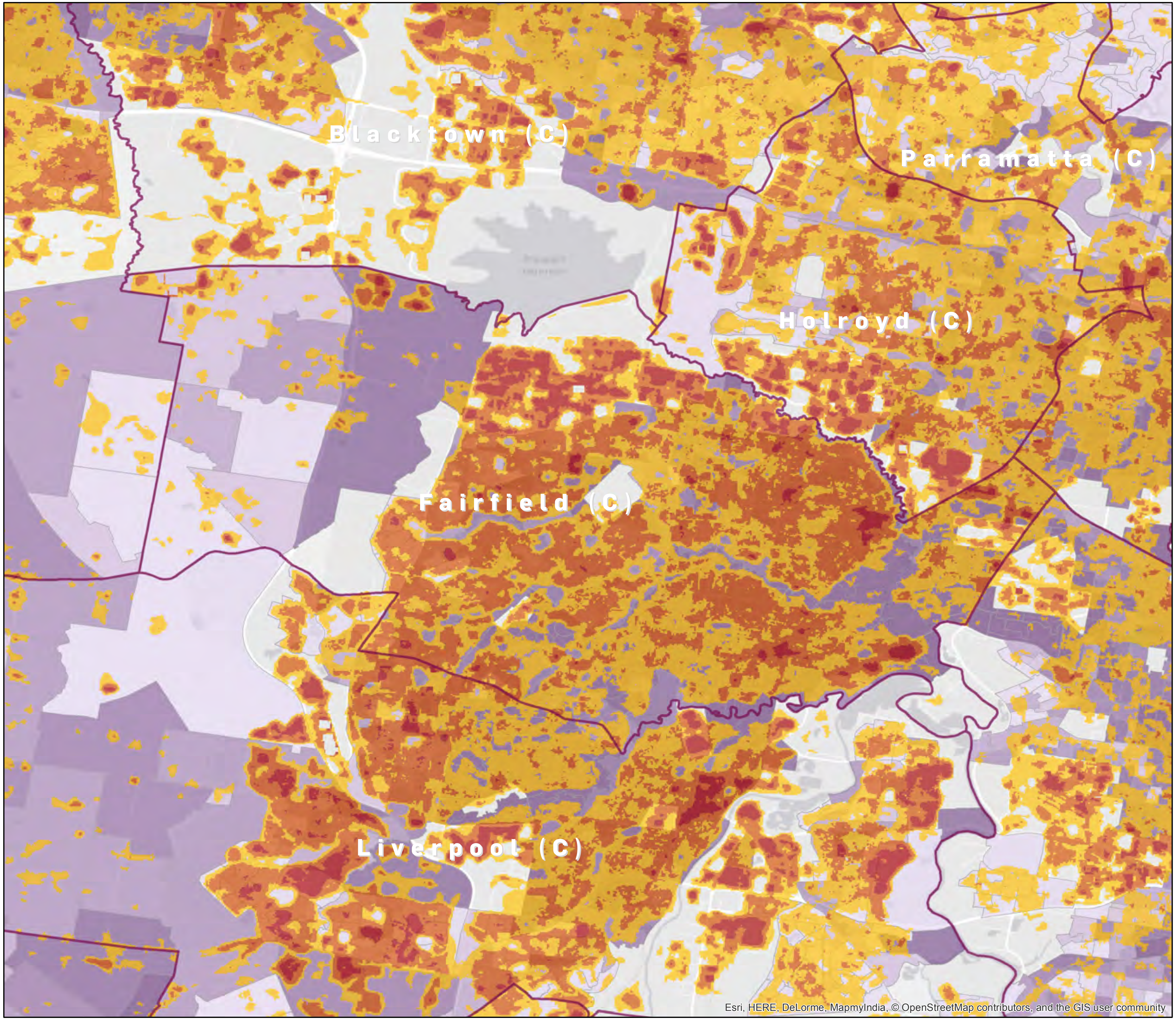
**Degrees Above Mean**

- 9.1 - 11.2
- 11.2 - 13.3
- Over 13.3

0 0.55 1.1 Kilometers



Date: 11/05/2017




# Legend

## Fairfield
## New South Wales

**Index of Relative Socio-economic Disadvantage**

More Disadvantaged

Less Disadvantaged

**Degrees Above Mean**

9.1 - 11.2

11.2 - 13.3

Over 13.3

20 20 20 VISION™

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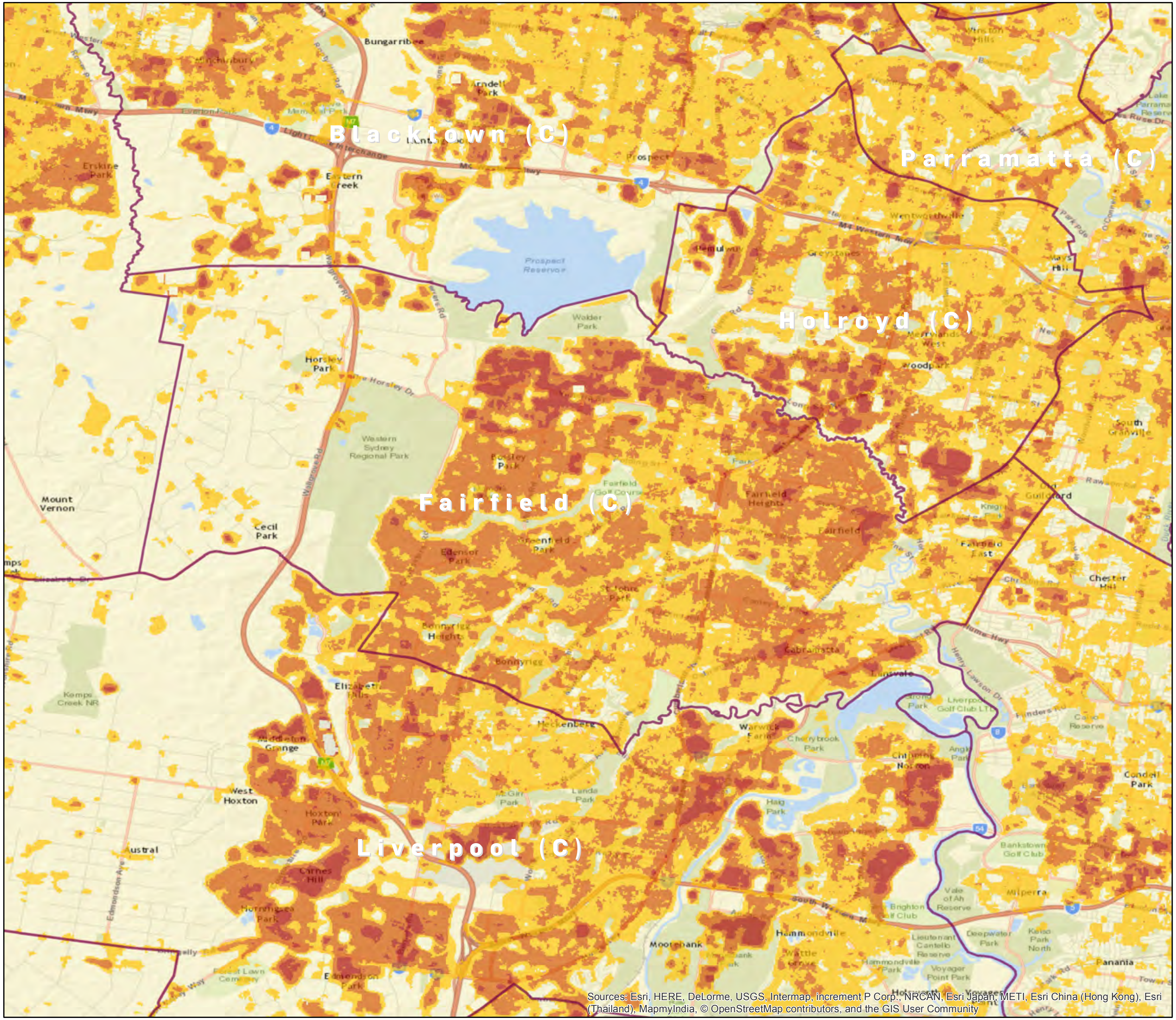
RMIT UNIVERSITY

0 1 2 Kilometers



Date: 11/05/2017




## Legend

**Fairfield**
**New South Wales**

**Degrees Above Mean**

9.1 - 11.2
11.2 - 13.3
Over 13.3

202020 VISION

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RMIT UNIVERSITY

0 1 2 Kilometers



Date: 11/05/2017

# 3 Measuring risk from multiple variables

Section 3.1 page 56 shows the risk profiles of the different LGAs ordered by risk levels according to the methodology in section 6, page 16. At one extreme of the scale are those LGAs that have a combination of above median levels of heat, low canopy, poor human health and socio-economic outcomes and below median levels of growth in greening.

The growth in greening plays an important part in the LGAs in NSW in reducing their risk profiles. However, it should be re-emphasised that the these LGAs may in fact be losing green cover but this will be at a lower than median rate compared to the rest of country.

The following is an explanation of the columns:

- Canopy heat = % hotspot in each LGA by % canopy cover (Figure 11).
- Health = Self-Assessed Health by ASR100 for each LGA by Prevalence of diabetes by ASR100 (Figure 12).
- Economic = SEIFA Index of Relative Socio-Economic Disadvantage in each LGA by SEIFA Index of Economic Resources (Figure 13).
- Green gain = rate of total green loss in each LGA by canopy cover loss (Figure 14)
- Vulnerable pop = rate of % population under 5 in each LGA versus % population over 65 and living alone (Figure 15)

| LGA_CODE1 | NAME | LGA_NAME11 | STATE | Canopy Heat | Health | Economic | Green gain | Vulnerable pop | Total | Risk Level |
|---|---|---|---|---|---|---|---|---|---|---|
| 20570 | Ballarat, City of | Ballarat | VIC | 0 | 1 | 0 | 0 | 0 | 1 | 0.5 |
| 21890 | Darebin, City of | Darebin | VIC | 1 | 0 | 0 | 0 | 0 | 1 | 0.5 |
| 23270 | Hume, City of | Hume | VIC | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 41060 | Charles Sturt, City of | Charles Sturt (C) | SA | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 42030 | Gawler, Town of | Gawler (T) | SA | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 45680 | Playford, City of | Playford (C) | SA | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 45890 | Port Adelaide Enfield, City of | Port Adelaide Enfield (C) | SA | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 48410 | West Torrens, City of | West Torrens (C) | SA | 0 | 0 | 0 | 0 | 1 | 1 | 0.5 |
| 50490 | Belmont, City of | Belmont | WA | 0 | 0 | 0 | 1 | 0 | 1 | 0.5 |
| 10750 | Blacktown, City of | Blacktown | NSW | 0 | 0 | 0 | 1 | 1 | 2 | 1 |
| 11100 | Botany Bay, City of | Botany Bay | NSW | 0 | 0 | 0 | 2 | 0 | 2 | 1 |
| 11550 | Canterbury, City of | Canterbury | NSW | 0 | 0 | 0 | 1 | 1 | 2 | 1 |
| 13950 | Holroyd, City of | Holroyd | NSW | 0 | 0 | 0 | 1 | 1 | 2 | 1 |
| 16650 | Rockdale, City | Rockdale | NSW | 0 | 0 | 0 | 2 | 0 | 2 | 1 |
| 21180 | Brimbank, City of | Brimbank | VIC | 0 | 0 | 0 | 1 | 1 | 2 | 1 |
| 24330 | Maribyrnong, City of | Maribyrnong | VIC | 1 | 0 | 0 | 0 | 1 | 2 | 1 |
| 25250 | Moreland, City of | Moreland | VIC | 1 | 0 | 0 | 1 | 0 | 2 | 1 |
| 44060 | Marion, City of | Marion (C) | SA | 1 | 0 | 0 | 0 | 1 | 2 | 1 |
| 47140 | Salisbury, City of | Salisbury (C) | SA | 0 | 0 | 0 | 1 | 1 | 2 | 1 |
| 54830 | Kwinana, City of | Kwinana | WA | 0 | 0 | 1 | 0 | 1 | 2 | 1 |
| 64010 | Launceston, City of | Launceston | TAS | 1 | 0 | 0 | 1 | 0 | 2 | 1 |
| 10200 | Auburn City | Auburn | NSW | 0 | 0 | 0 | 2 | 1 | 3 | 1.5 |
| 10350 | Bankstown, City | Bankstown | NSW | 1 | 0 | 0 | 1 | 1 | 3 | 1.5 |
| 11500 | Campbelltown, City of | Campbelltown (C) | NSW | 1 | 0 | 0 | 1 | 1 | 3 | 1.5 |
| 12850 | Fairfield, City | Fairfield | NSW | 0 | 0 | 0 | 2 | 1 | 3 | 1.5 |
| 14900 | Liverpool, City of | Liverpool | NSW | 0 | 0 | 1 | 1 | 1 | 3 | 1.5 |
| 22170 | Frankston, City of | Frankston | VIC | 1 | 1 | 0 | 1 | 0 | 3 | 1.5 |
| 22620 | Greater Bendigo, City of | Greater Bendigo | VIC | 1 | 1 | 0 | 1 | 0 | 3 | 1.5 |
| 22670 | Greater Dandenong, City of | Greater Dandenong | VIC | 1 | 0 | 0 | 1 | 1 | 3 | 1.5 |
| 22750 | Greater Geelong, City of | Greater Geelong | VIC | 0 | 1 | 0 | 1 | 1 | 3 | 1.5 |
| 23110 | Hobsons Bay, City of | Hobsons Bay | VIC | 1 | 0 | 1 | 1 | 0 | 3 | 1.5 |
| 24650 | Melton, City of | Melton | VIC | 0 | 0 | 2 | 0 | 1 | 3 | 1.5 |
| 40070 | Adelaide Hills Council | Adelaide Hills (DC) | SA | 1 | 0 | 1 | 0 | 1 | 3 | 1.5 |
| 45340 | Onkaparinga, City of | Onkaparinga (C) | SA | 0 | 0 | 0 | 2 | 1 | 3 | 1.5 |
| 51820 | Cockburn, City of | Cockburn | WA | 0 | 0 | 2 | 0 | 1 | 3 | 1.5 |
| 58510 | Victoria Park, Town of | Victoria Park | WA | 1 | 0 | 1 | 0 | 1 | 3 | 1.5 |
| 61410 | Clarence, City of | Clarence | TAS | 2 | 0 | 0 | 1 | 0 | 3 | 1.5 |
| 62610 | Glenorchy, City of | Glenorchy | TAS | 2 | 0 | 0 | 1 | 0 | 3 | 1.5 |
| 10150 | Ashfield, Municipality of | Ashfield | NSW | 0 | 0 | 1 | 1 | 2 | 4 | 2 |
| 11300 | Burwood Council | Burwood | NSW | 0 | 0 | 0 | 2 | 2 | 4 | 2 |
| 11520 | Canada Bay, City of | Canada Bay | NSW | 0 | 1 | 2 | 0 | 1 | 4 | 2 |
| 15200 | Marrickville Council | Marrickville | NSW | 0 | 0 | 1 | 2 | 1 | 4 | 2 |
| 15900 | Newcastle, City of | Newcastle | NSW | 1 | 1 | 0 | 1 | 1 | 4 | 2 |
| 16250 | Parramatta, City of | Parramatta | NSW | 1 | 0 | 0 | 2 | 1 | 4 | 2 |
| 17100 | Strathfield, Municipality of | Strathfield | NSW | 0 | 1 | 1 | 0 | 2 | 4 | 2 |
| 25060 | Moonee Valley, City of | Moonee Valley | VIC | 0 | 1 | 1 | 1 | 1 | 4 | 2 |
| 27070 | Whittlesea, City of | Whittlesea | VIC | 1 | 0 | 1 | 1 | 1 | 4 | 2 |
| 27260 | Wyndham, City of | Wyndham | VIC | 0 | 0 | 2 | 1 | 1 | 4 | 2 |
| 33960 | Ipswich, City of | Ipswich | QLD | 1 | 0 | 0 | 2 | 1 | 4 | 2 |
| 34590 | Logan City | Logan | QLD | 1 | 0 | 1 | 1 | 1 | 4 | 2 |
| 36910 | Toowoomba Regional Council | Toowoomba | QLD | 1 | 1 | 0 | 2 | 0 | 4 | 2 |
| 40910 | Campbelltown, City of | Campbelltown | SA | 1 | 0 | 1 | 1 | 1 | 4 | 2 |
| 42600 | Holdfast Bay, City of | Holdfast Bay (C) | SA | 1 | 1 | 1 | 0 | 1 | 4 | 2 |
| 50350 | Bassendean, Town of | Bassendean | WA | 0 | 1 | 1 | 2 | 0 | 4 | 2 |
| 58050 | Swan, City of | Swan | WA | 1 | 0 | 2 | 0 | 1 | 4 | 2 |
| 58760 | Wanneroo, City of | Wanneroo | WA | 0 | 0 | 2 | 1 | 1 | 4 | 2 |
| 71000 | Darwin, City of | Darwin | NT | 1 | 0 | 2 | 0 | 1 | 4 | 2 |
| 14150 | Hurstville, City of | Hurstville | NSW | 1 | 0 | 1 | 1 | 2 | 5 | 2.5 |
| 16350 | Penrith, City of | Penrith | NSW | 1 | 0 | 1 | 2 | 1 | 5 | 2.5 |
| 16550 | Randwick, City of | Randwick | NSW | 0 | 1 | 1 | 2 | 1 | 5 | 2.5 |
| 22310 | Glen Eira, City of | Glen Eira | VIC | 1 | 2 | 2 | 0 | 0 | 5 | 2.5 |
| 23430 | Kingston, City of | Kingston | VIC | 1 | 2 | 2 | 0 | 0 | 5 | 2.5 |
| 26350 | Stonnington, City of | Stonnington | VIC | 1 | 2 | 1 | 0 | 1 | 5 | 2.5 |
| 32070 | Cairns Regional Council | Cairns | QLD | 1 | 1 | 0 | 2 | 1 | 5 | 2.5 |
| 45290 | Norwood Payneham & St Peters, City of | Norwood Payneham St Peters (C) | SA | 1 | 0 | 1 | 2 | 1 | 5 | 2.5 |
| 46510 | Prospect, City of | Prospect (C) | SA | 1 | 1 | 1 | 1 | 1 | 5 | 2.5 |
| 50210 | Armadale, City of | Armadale | WA | 1 | 0 | 1 | 2 | 1 | 5 | 2.5 |
| 53430 | Fremantle, City of | Fremantle | WA | 1 | 0 | 1 | 2 | 1 | 5 | 2.5 |
| 53780 | Gosnells, City of | Gosnells | WA | 1 | 0 | 2 | 1 | 1 | 5 | 2.5 |
| 57080 | Perth, City of | Perth | WA | 1 | 1 | 1 | 0 | 2 | 5 | 2.5 |
| 57490 | Rockingham, City of | Rockingham | WA | 0 | 1 | 2 | 1 | 1 | 5 | 2.5 |
| 72800 | Palmerston, City of | Palmerston | NT | 1 | 0 | 2 | 1 | 1 | 5 | 2.5 |
| 11450 | Camden Council | Camden | NSW | 0 | 2 | 2 | 1 | 1 | 6 | 3 |
| 17200 | Sydney, City of | Sydney | NSW | 0 | 1 | 1 | 2 | 2 | 6 | 3 |
| 20660 | Banyule, City of | Banyule | VIC | 2 | 2 | 2 | 0 | 0 | 6 | 3 |
| 21610 | Casey, City of | Casey | VIC | 0 | 1 | 2 | 2 | 1 | 6 | 3 |
| 24410 | Maroondah, City of | Maroondah | VIC | 2 | 2 | 2 | 0 | 0 | 6 | 3 |
| 25900 | Port Phillip, City of | Port Phillip | VIC | 1 | 2 | 1 | 1 | 1 | 6 | 3 |
| 35010 | Moreton Bay Region | Moreton Bay | QLD | 1 | 1 | 2 | 1 | 1 | 6 | 3 |
| 36710 | Sunshine Coast | Sunshine Coast | QLD | 1 | 1 | 2 | 1 | 1 | 6 | 3 |
| 47980 | Unley, City of | Unley (C) | SA | 2 | 1 | 2 | 0 | 1 | 6 | 3 |
| 48260 | Walkerville, Town of | Walkerville (M) | SA | 2 | 1 | 2 | 0 | 1 | 6 | 3 |
| 50420 | Bayswater, City of | Bayswater | WA | 1 | 0 | 2 | 2 | 1 | 6 | 3 |
| 51310 | Cambridge, Town of | Cambridge | WA | 1 | 2 | 2 | 0 | 1 | 6 | 3 |
| 53150 | East Fremantle, Town of | East Fremantle | WA | 1 | 2 | 2 | 0 | 1 | 6 | 3 |
| 55320 | Melville, City of | Melville | WA | 1 | 2 | 2 | 0 | 1 | 6 | 3 |
| 57910 | Stirling, City of | Stirling | WA | 1 | 1 | 2 | 1 | 1 | 6 | 3 |
| 63610 | Kingborough Council | Kingborough | TAS | 2 | 1 | 2 | 1 | 0 | 6 | 3 |
| 14100 | Hunter's Hill, Municipality of | Hunters Hill | NSW | 2 | 2 | 2 | 0 | 1 | 7 | 3.5 |
| 14450 | Kogarah, City of | Kogarah | NSW | 1 | 1 | 2 | 1 | 2 | 7 | 3.5 |
| 15150 | Manly Council | Manly | NSW | 2 | 2 | 2 | 1 | 0 | 7 | 3.5 |
| 16370 | Pittwater Council | Pittwater | NSW | 2 | 2 | 2 | 1 | 0 | 7 | 3.5 |
| 16700 | Ryde, City of | Ryde | NSW | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 17420 | The Hills Shire | The Hills Shire | NSW | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 18000 | Warringah Council | Warringah | NSW | 2 | 2 | 2 | 1 | 0 | 7 | 3.5 |
| 18050 | Waverley Council | Waverley | NSW | 1 | 2 | 2 | 2 | 0 | 7 | 3.5 |

| LGA_CODE1 | NAME | LGA_NAME11 | STATE | Canopy Heat | Health | Economic | Green gain | Vulnerable pop | Total | Risk Level |
|---|---|---|---|---|---|---|---|---|---|---|
| 21110 | Boroondara, City of | Boroondara | VIC | 2 | 2 | 2 | 0 | 1 | 7 | 3.5 |
| 21450 | Cardinia, Shire of | Cardinia | VIC | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 24600 | Melbourne, City of | Melbourne | VIC | 1 | 2 | 1 | 1 | 2 | 7 | 3.5 |
| 24970 | Monash, City of | Monash | VIC | 1 | 2 | 2 | 0 | 2 | 7 | 3.5 |
| 25340 | Mornington Peninsula, Shire of | Mornington Peninsula | VIC | 2 | 2 | 2 | 0 | 1 | 7 | 3.5 |
| 33430 | Gold Coast City | Gold Coast | QLD | 1 | 1 | 2 | 1 | 2 | 7 | 3.5 |
| 36250 | Redland City | Redland | QLD | 1 | 1 | 2 | 1 | 2 | 7 | 3.5 |
| 37010 | Townsville City Council | Townsville | QLD | 1 | 1 | 2 | 2 | 1 | 7 | 3.5 |
| 54170 | Joondalup, City of | Joondalup | WA | 1 | 2 | 2 | 0 | 2 | 7 | 3.5 |
| 55740 | Mosman Park, Town of | Mosman Park | WA | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 56580 | Nedlands, City of | Nedlands | WA | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 57840 | South Perth, City of | South Perth | WA | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 57980 | Subiaco, City of | Subiaco | WA | 2 | 2 | 1 | 1 | 1 | 7 | 3.5 |
| 58570 | Vincent, City of | Vincent | WA | 1 | 1 | 2 | 2 | 1 | 7 | 3.5 |
| 62810 | Hobart, City of | Hobart | TAS | 2 | 2 | 1 | 1 | 1 | 7 | 3.5 |
| 89399 | ACT | Unincorporated ACT | ACT | 1 | 2 | 2 | 1 | 1 | 7 | 3.5 |
| 14700 | Lane Cove, Municipality of | Lane Cove | NSW | 2 | 2 | 2 | 2 | 0 | 8 | 4 |
| 14800 | Leichhardt, Municipality of | Leichhardt | NSW | 1 | 2 | 2 | 2 | 1 | 8 | 4 |
| 15950 | North Sydney Council | North Sydney | NSW | 2 | 2 | 2 | 1 | 1 | 8 | 4 |
| 17150 | Sutherland Shire | Sutherland Shire | NSW | 2 | 2 | 2 | 2 | 0 | 8 | 4 |
| 18250 | Willoughby, City of | Willoughby | NSW | 2 | 2 | 2 | 1 | 1 | 8 | 4 |
| 24210 | Manningham, City of | Manningham | VIC | 2 | 2 | 2 | 0 | 2 | 8 | 4 |
| 26980 | Whitehorse, City of | Whitehorse | VIC | 2 | 2 | 2 | 1 | 1 | 8 | 4 |
| 27350 | Yarra, City of | Yarra | VIC | 2 | 1 | 1 | 2 | 2 | 8 | 4 |
| 31000 | Brisbane, City of | Brisbane | QLD | 1 | 2 | 2 | 1 | 2 | 8 | 4 |
| 40700 | Burnside, City of | Burnside (C) | SA | 2 | 2 | 2 | 1 | 1 | 8 | 4 |
| 51330 | Canning, City of | Canning | WA | 1 | 1 | 2 | 2 | 2 | 8 | 4 |
| 52170 | Cottesloe, Town of | Cottesloe | WA | 1 | 2 | 2 | 2 | 1 | 8 | 4 |
| 54200 | Kalamunda, Shire of | Kalamunda | WA | 2 | 2 | 2 | 1 | 1 | 8 | 4 |
| 56090 | Mundaring, Shire of | Mundaring | WA | 1 | 2 | 2 | 1 | 2 | 8 | 4 |
| 56930 | Peppermint Grove, Shire of | Peppermint Grove | WA | 2 | 2 | 2 | 0 | 2 | 8 | 4 |
| 14000 | Hornsby Shire | Hornsby | NSW | 2 | 2 | 2 | 1 | 2 | 9 | 4.5 |
| 14500 | Ku-ring-gai Council | Ku-ring-gai | NSW | 2 | 2 | 2 | 1 | 2 | 9 | 4.5 |
| 15350 | Mosman, Municipality of | Mosman | NSW | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |
| 18500 | Woollahra, Municipality of | Woollahra | NSW | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |
| 20910 | Bayside, City of | Bayside | VIC | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |
| 23670 | Knox, City of | Knox | VIC | 2 | 2 | 2 | 1 | 2 | 9 | 4.5 |
| 25710 | Nillumbik, Shire of | Nillumbik | VIC | 2 | 2 | 2 | 1 | 2 | 9 | 4.5 |
| 27450 | Yarra Ranges, Shire of | Yarra Ranges | VIC | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |
| 40120 | Adelaide, City of | Adelaide (C) | SA | 1 | 2 | 2 | 2 | 2 | 9 | 4.5 |
| 44340 | Mitcham, City of | Mitcham (C) | SA | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |
| 47700 | Tea Tree Gully, City of | Tea Tree Gully (C) | SA | 2 | 1 | 2 | 2 | 2 | 9 | 4.5 |
| 51750 | Claremont, Town of | Claremont | WA | 2 | 2 | 2 | 2 | 1 | 9 | 4.5 |