

# WHERE SHOULD ALL THE TREES GO?

**202020<sup>TM</sup>**  
**VISION**

20% MORE GREEN SPACES  
IN URBAN AREAS BY 2020



# WHAT IS THIS REPORT?



*In 2013, the 202020 Vision released 'Where are all the trees?', Australia's first national benchmark of urban canopy cover.*

*This is the next generation of that report.*

*Like the original, it maps 139 local governments, providing updated snapshots of urban canopy cover.*

Download it from [202020vision.com.au](http://202020vision.com.au)

2013

2017

## CREDITS & AUTHORSHIP

This document is based in its entirety on:

Amati, M. Boruff, B. Caccetta, P. Devereux,  
D. Kaspar, J. Phelan K. and Saunders, A. (2017).

*Where should all the trees go? Investigating the impact of tree canopy cover on socio-economic status and wellbeing in LGA's prepared for Hort Innovation by the Centre for Urban Research, RMIT University.*



*The updated 'Where should all the trees go?' report extends the original report to measure overall vulnerability based on heat mapping and socio-demographic data.*

*Research is then enriched with council conversations to create a holistic understanding of contributing factors.*

*In doing so, this report seeks to build on the question, 'Where are all the trees?', to find out 'Where should all the trees go?'.*





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# NATIONAL OVERVIEW

*Australia,  
it's a big place.*

**7.692  
million km<sup>2</sup>**

*Habitable land:*

**768,685 km<sup>2</sup>**

*But most people live  
in a small part of it.*

**89.5%**  
*people live in around*  
**10%**  
*of the country*

*That's*

**21.6 million**  
*people in cities and surrounding suburbs.*

*We need to put  
green space where  
it's most needed.*



*We do this by understanding where  
it's being lost, where it's hot and where  
people will benefit most.*

*But where should  
all the trees go?*



*We asked RMIT to identify the urban areas  
that would most benefit from more green  
space. Here's what they told us...*





Our method:

# THE VHHEDA VULNERABILITY INDEX

(Vulnerability to Heat, poor Health, Economic Disadvantage and Access to green spaces)

A brand new tool that measures the vulnerability of an area based on:

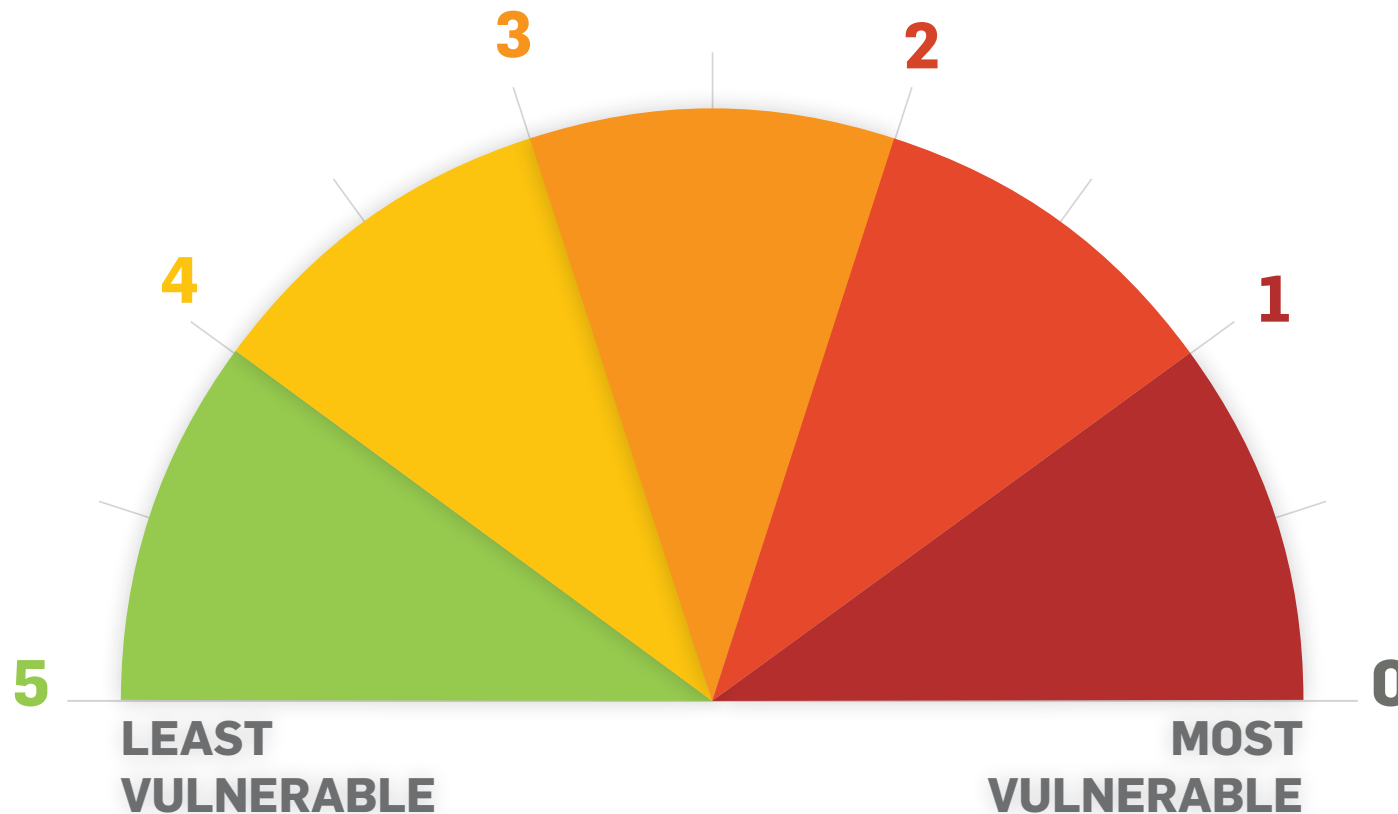
**Heat:** On the hottest days, how hot does this area get?

**Health:** Are people in the area healthy and able to cope with prolonged, increased heat?

**Trends:** Is the area currently losing, gaining or retaining its green space?

WANT TO KNOW HOW THIS  
WAS DEVELOPED?

Head to our Methodology chapter.



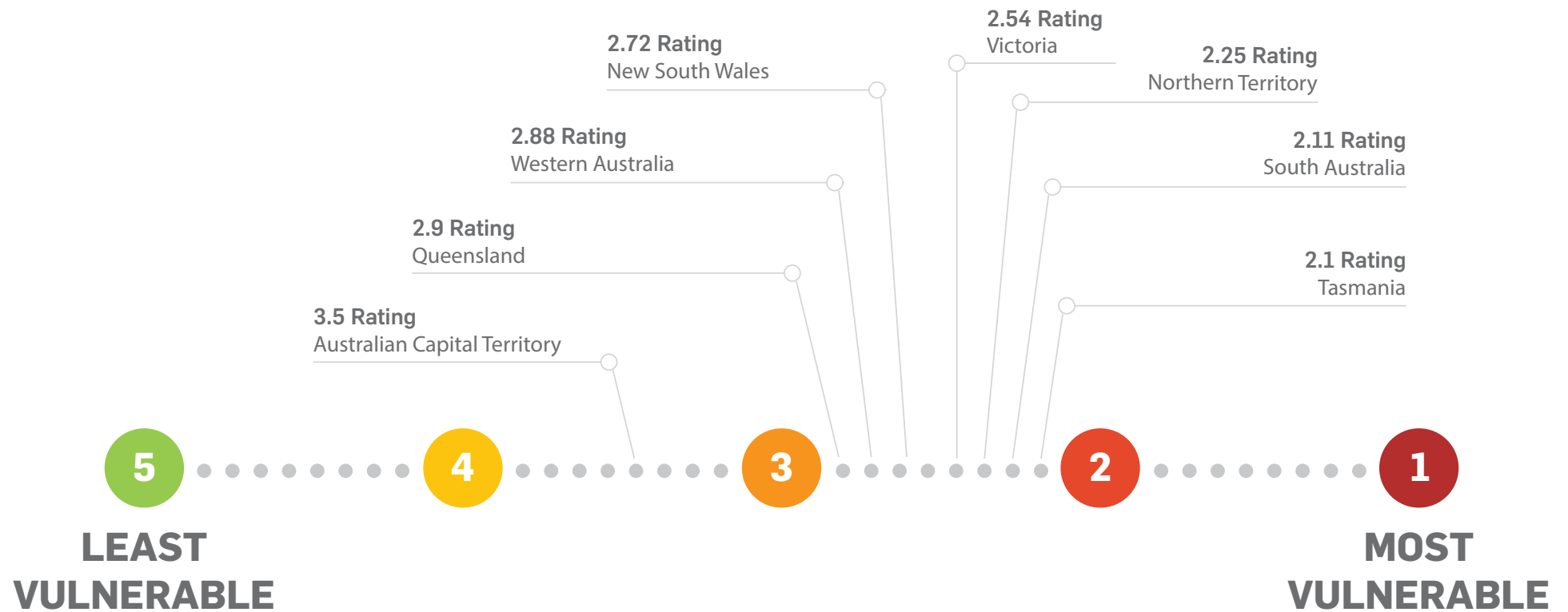
The higher an area's vulnerability rating, the better able it is to cope.

The lower the number, the more vulnerable.

*So where should all the trees go?  
In the most vulnerable places first.*



# VULNERABILITY BY STATE

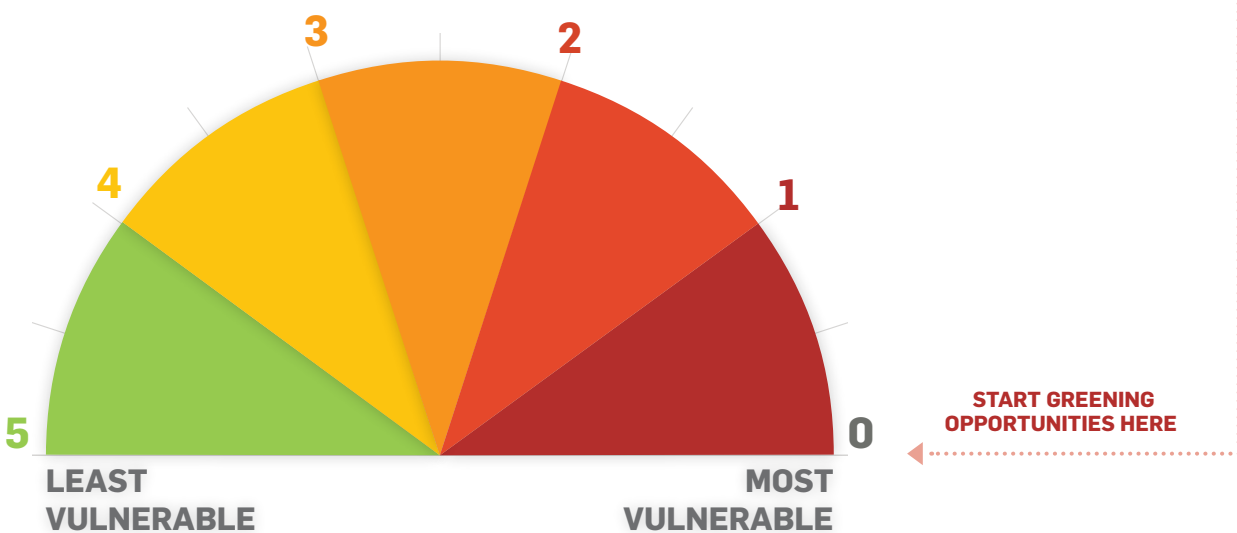






# VULNERABILITY BY LGA

<b>4.5 Rating</b> Hornsby Shire Ku-ring-gai Council Municipality of Mosman Municipality of Woollahra City of Bayside (VIC) City of Knox Shire of Nillumbik Shire of Yarra Ranges City of Adelaide City of Mitcham City of Tea Tree Gully Town of Claremont	<b>4.0 Rating</b> Municipality of Lane Cove Municipality of Leichhardt North Sydney Council Sutherland Shire City of Willoughby City of Manningham City of Whitehorse City of Yarra City of Brisbane City of Burnside City of Canning Town of Cottesloe Shire of Kalamunda Shire of Mundaring Shire of Peppermint Grove	<b>3.5 Rating</b> Municipality of Hunter's Hill City of Kogarah Manly Council Pittwater Council City of Ryde The Hills Shire Warringah Council Waverley Council City of Boroondara Shire of Cardinia City of Melbourne City of Monash Shire of Mornington Peninsula Gold Coast City Redland City Townsville City Council City of Joondalup Town of Mosman Park City of Nedlands City of South Perth City of Subiaco City of Vincent City of Hobart ACT	<b>3.0 Rating</b> Camden Council City of Sydney City of Banyule City of Casey City of Maroondah City of Port Phillip Moreton Bay Region Sunshine Coast City of Unley Town of Walkerville City of Bayswater Town of Cambridge Town of East Fremantle City of Melville City of Stirling Kingborough Council	<b>2.5 Rating</b> City of Hurstville City of Penrith City of Randwick City of Glen Eira City of Kingston City of Stonnington Cairns Regional Council City of Norwood Payneham & St Peters City of Prospect City of Armadale City of Fremantle City of Gosnells City of Perth City of Rockingham City of Palmerston	<b>2.0 Rating</b> Municipality of Ashfield Burwood Council City of Canada Bay Marrickville Council City of Newcastle City of Parramatta Municipality of Strathfield City of Moonee Valley City of Whittlesea City of Wyndham City of Ipswich Logan City Toowoomba Regional Council City of Campbelltown (SA) City of Holdfast Bay Town of Bassendean Town of Swan City of Wanneroo City of Darwin	<b>1.5 Rating</b> Auburn City Bankstown City City of Campbelltown (NSW) Fairfield City City of Liverpool City of Frankston City of Greater Bendigo City of Greater Dandenong City of Greater Geelong City of Hobsons Bay City of Melton Adelaide Hills Council City of Onkaparinga City of Cockburn Town of Victoria Park City of Clarence City of Glenorchy	<b>1.0 Rating</b> City of Blacktown City of Botany Bay City of Canterbury City of Holroyd Rockdale City City of Brimbank City of Maribyrnong City of Moreland City of Marion City of Salisbury City of Kwinana City of Launceston	<b>0.5 Rating</b> City of Ballarat City of Darebin City of Hume City of Charles Sturt Town of Gawler City of Playford City of Port Adelaide Enfield City of West Torrens City of Belmont
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# TOP 50 GREENING OPPORTUNITIES IN AUSTRALIA

(BASED ON THE VHEDA INDEX)





# CURRENT GREEN COVER

NT

**24.4%**

hard surface cover

**75.5%**

green cover

+ 6.35% increase  
in hard surface\*

WA

**41.22%**

hard surface cover

**58.78%**

green cover

+ 2.09% increase  
in hard surface\*

SA

**43.2%**

hard surface cover

**56.8%**

green cover

+ 2.57% increase  
in hard surface\*

VIC

**37.26%**

hard surface cover

**62.74%**

green cover

+ 3.01% increase  
in hard surface\*

TAS

**9.96%**

hard surface cover

**90.04%**

green cover

+ 0.82% increase  
in hard surface\*

QLD

**9.9%**

hard surface cover

**90.1%**

green cover

+ 1.79% increase  
in hard surface\*

NSW

**42.79%**

hard surface cover

**57.21%**

green cover

+ 3.01% increase  
in hard surface\*

ACT

**7.4%**

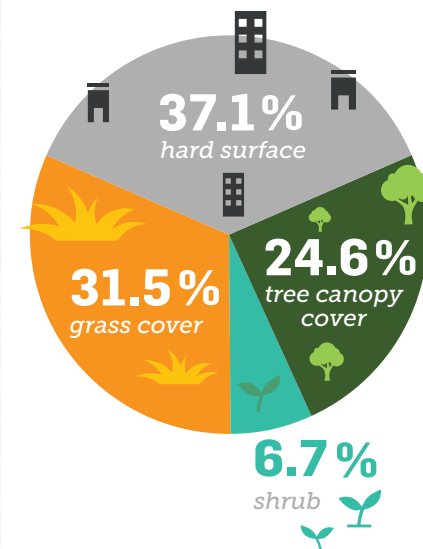
hard surface cover

**92.6%**

green cover

+ 2.2% increase  
in hard surface\*

National urban average comparison



In 'Where are all the trees', the national average was calculated by averaging the state averages. In this report we have chosen to update the methodology to make the national average an average of all LGAs, as we believe it more accurately represents the true figure.



**79%**  
Highest tree  
canopy



**3.2%**  
Lowest tree  
canopy

\*changes represented since 2009

WHERE SHOULD ALL THE TREES GO? NATIONAL OVERVIEW





# WHAT'S CHANGED?

2009 TO 2017

## CANOPY COVER



**35%**

*of councils have undergone a significant decline.*



**61%**

*of councils have had no significant change.*



**4%**

*of councils have undergone a significant increase.*

## SHRUB COVER



**16%**

*of councils have undergone a significant decline.*



**67%**

*of councils have had no significant change.*



**17%**

*of councils have undergone a significant increase.*

## HARD SURFACES



**ZERO**

*councils have seen a significant decline.*

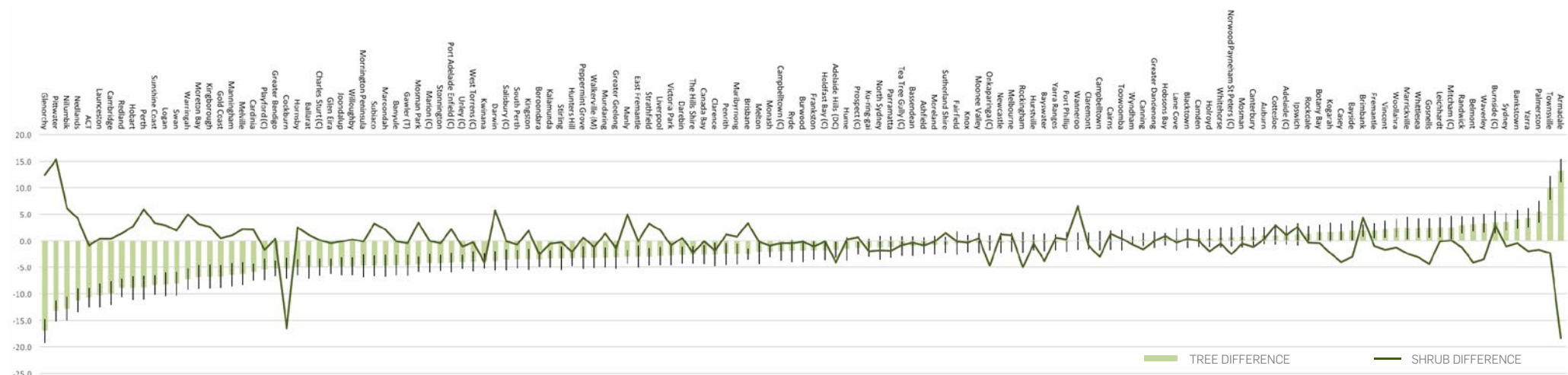


**34%**

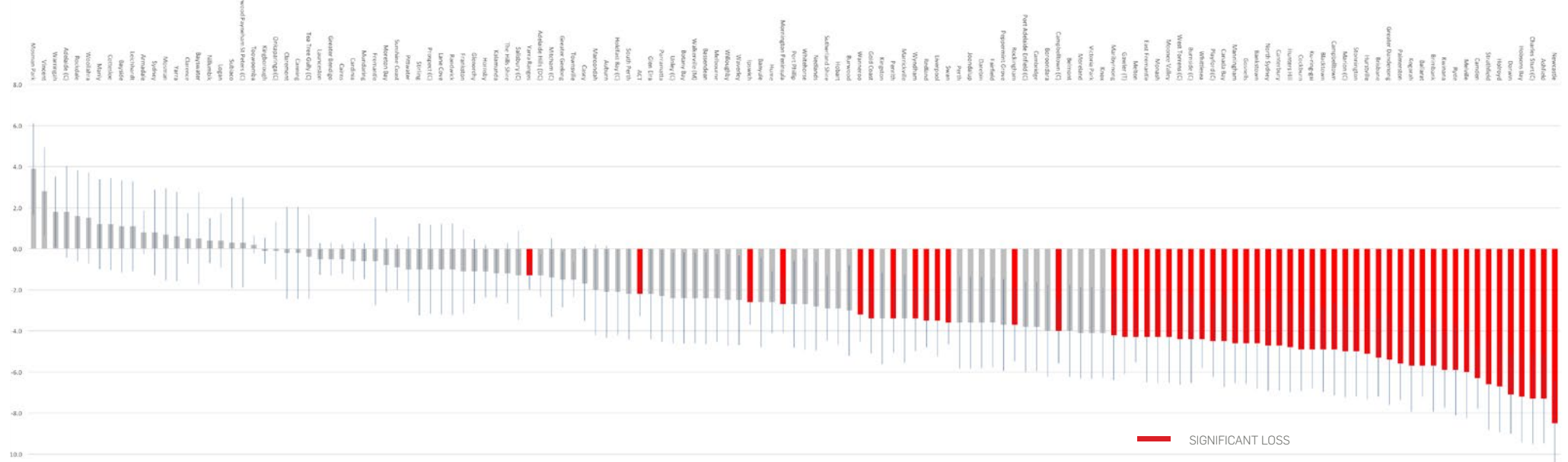
*of councils have undergone a significant increase.*



NATIONAL CHANGE IN URBAN FOREST AND SHRUB CANOPY COVER 2008-2013 TO 2016



NATIONAL GAIN AND LOSS IN GREEN COVER IN AUSTRALIA METROPOLITAN AREAS 2008-2013 TO 2016







# KEY TAKE-AWAYS

## THE GOOD NEWS:



A majority of councils have not experienced a significant increase in hard surface cover or loss of tree canopy and shrubbery.



Nationally, shrubbery decline is only half of tree canopy decline. As shrubs grow, they may compensate some canopy loss.



Councils that have gained the most significant tree canopy have lost shrubbery. This suggests that the gain in canopy may be the legacy of past plantings of small trees (shrubs) maturing into trees.



In many cases, a decline in canopy is matched by an equivalent increase in shrubbery. This suggests that canopy loss is being compensated for by re-planting.

## THE BAD NEWS:

Nationally, tree canopy and shrub cover has dropped by 2.1% over the past four years.

That's 4,041 km<sup>2</sup>, or 161,860 Melbourne Cricket Grounds of urban green space.



In many cases a decline in canopy and shrubbery is matched by an increase in hard surface and grassed areas. This suggests that development and clearing is replacing green spaces.



The rate of canopy loss is generally higher in LGAs which have the most canopy cover.





# NEW SOUTH WALES





Average canopy cover  
for urban NSW is

**26.64%**

down 0.83% from

**27.47%**

in 2009.



The highest canopy  
cover in an urban LGA is

**54%**

in Hornsby Shire.



The lowest canopy  
cover in an urban LGA is

**13.7%**

in both the City of Botany Bay  
and Rockdale City Council.



The most significant  
and beneficial gains  
could be made in the  
Bayside City Council,  
Cumberland Council,  
Inner West Council  
and Liverpool  
City Council.



Now that Bankstown City  
Council has merged with  
Canterbury City Council,  
the canopy figure across  
the amalgamated LGA will  
be reduced, as Canterbury  
City Council has

**2% LESS  
CANOPY.**



Despite the canopy gains  
in Bankstown City Councils  
there has been a

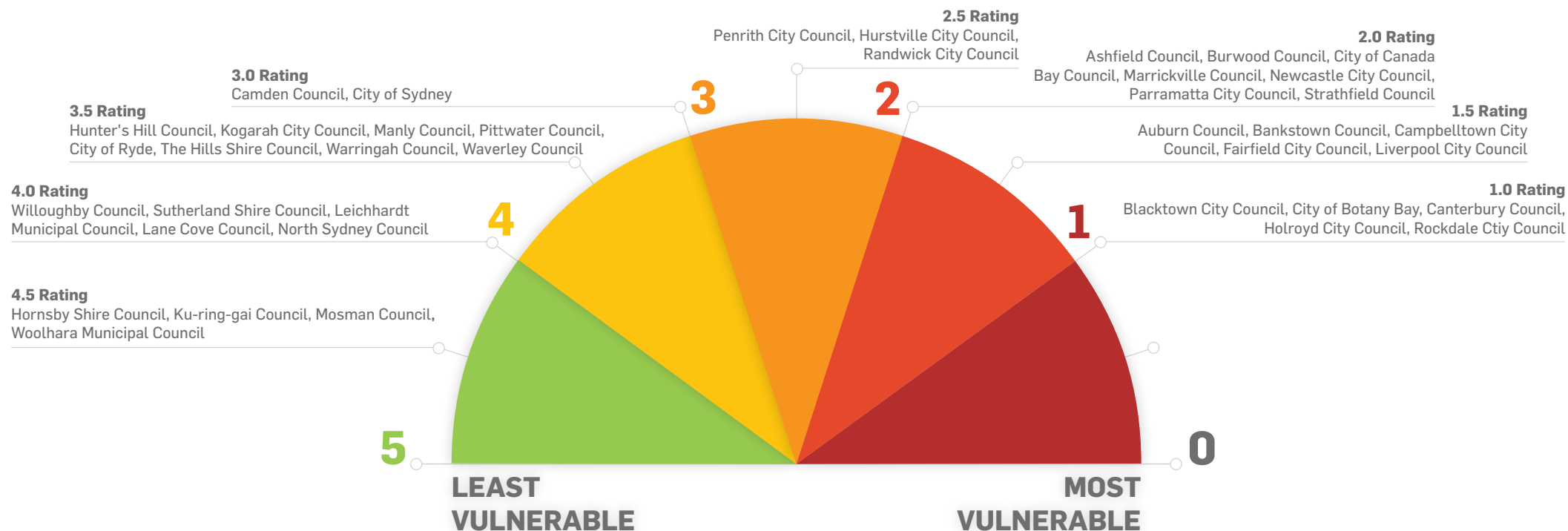
**SIGNIFICANT  
INCREASE  
IN HARD  
SURFACES.**



The most significant  
canopy loss was  
in Pittwater Council.

**▼ 13.2%**





### TOP URBAN GREENING OPPORTUNITIES:

Blacktown, Botany, Canterbury, Holroyd & Rockdale (which have all been affected by council amalgamations).

- Blacktown City Council, City of Botany Bay, Canterbury Council, Holroyd City Council, Rockdale City Council (1)
- Cumberland Council - Auburn Council (1.5), Holroyd City Council (1)
- Amalgamations between Canterbury (1) and Bankstown Councils (1.5)
- City of Parramatta Council - Auburn Council (1.5), Parramatta City Council (2)
- Holroyd City Council (1), Hornsby Shire Council (4.5)
- Inner West Council - Ashfield Council (2), Leichhardt Municipal Council (4), Marrickville Council (2)
- Northern Beaches Council - Manly Council, Pittwater Council, Warringah Council (3.5)





## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

Anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



### Shrub

Landscaped vegetation as well as bushland shrubs, crops and grapevines.



### Grass

Cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.

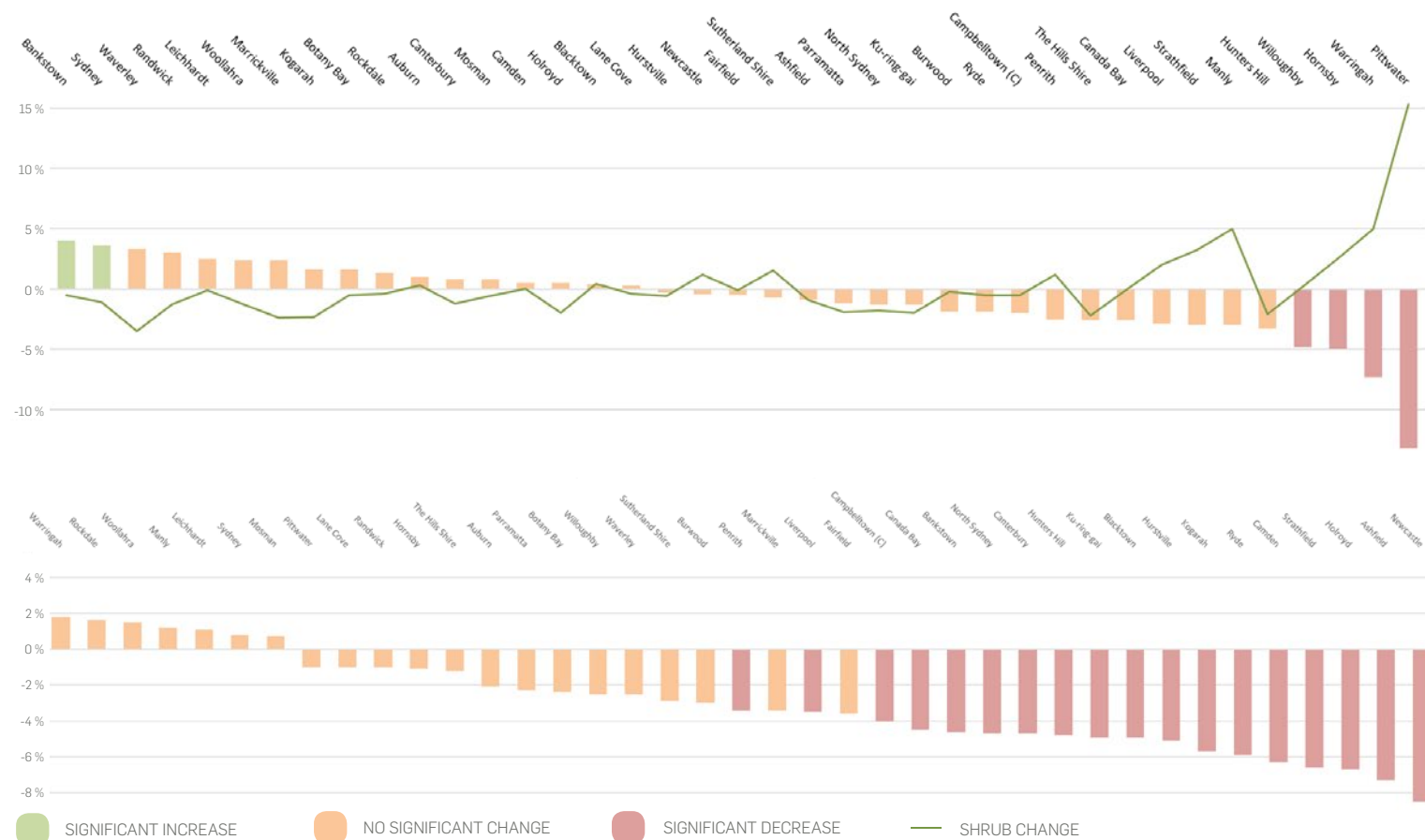


### Hard surfaces

Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

Tree Canopy Cover	27.47%	26.64%	0.83% Loss
Shrub Cover	7.01%	7.2%	0.19% Gain
Grass Cover	25.73%	23.36%	2.37% Loss
Hard Surface	39.8%	42.8%	3.0% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN NSW LGAs 2009-2016



\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)



# NSW – SYDNEY

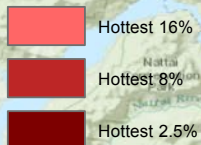
## URBAN HEAT ISLAND MAPPING

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas due to human impact of hard surfaces and development. Colours are used below to differentiate intensity of urban heat islands.

Tasman Sea

### Legend

#### Hottest Areas



0 5.5 11 Kilometers

Map by: Alex Saunders

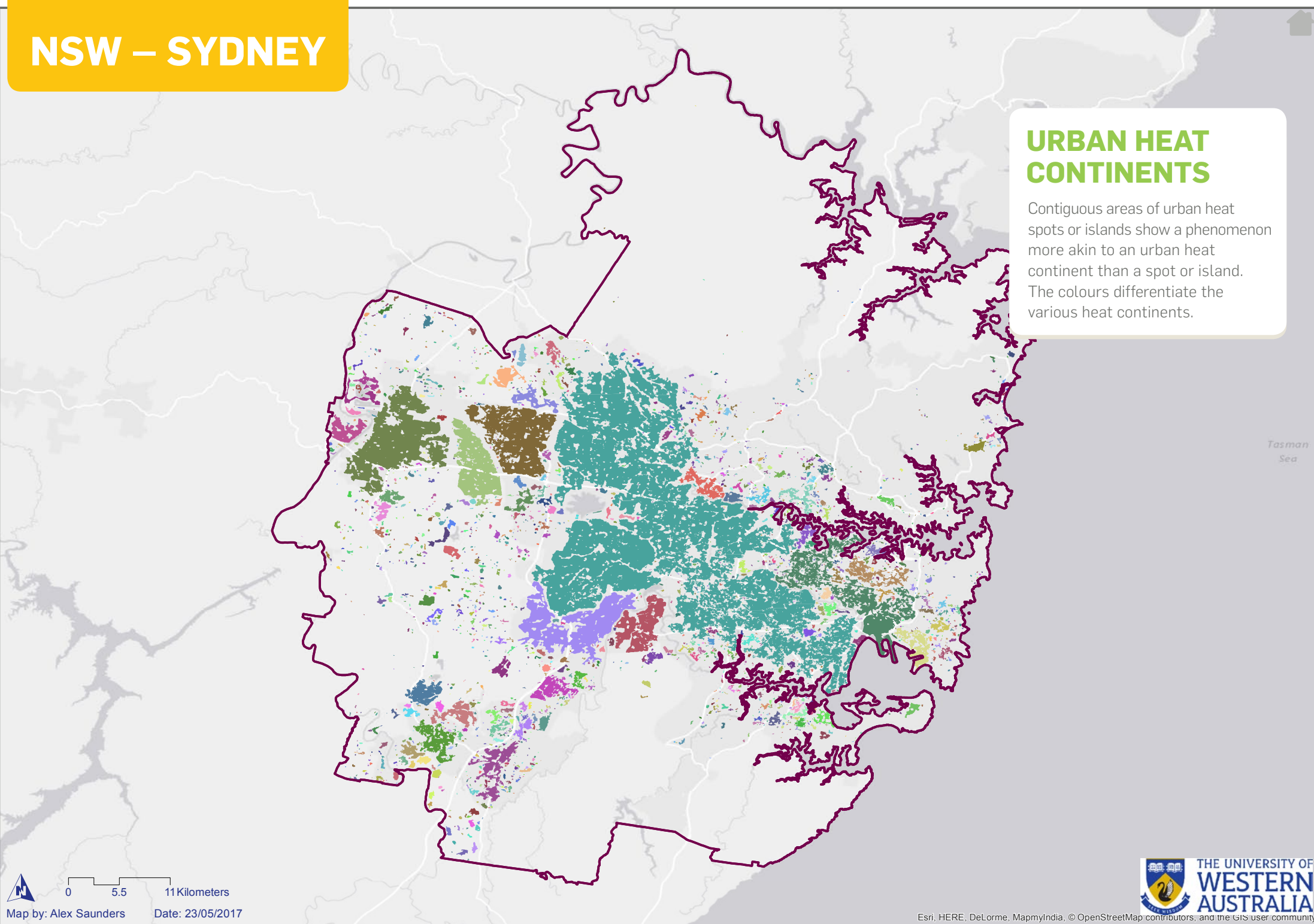
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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.

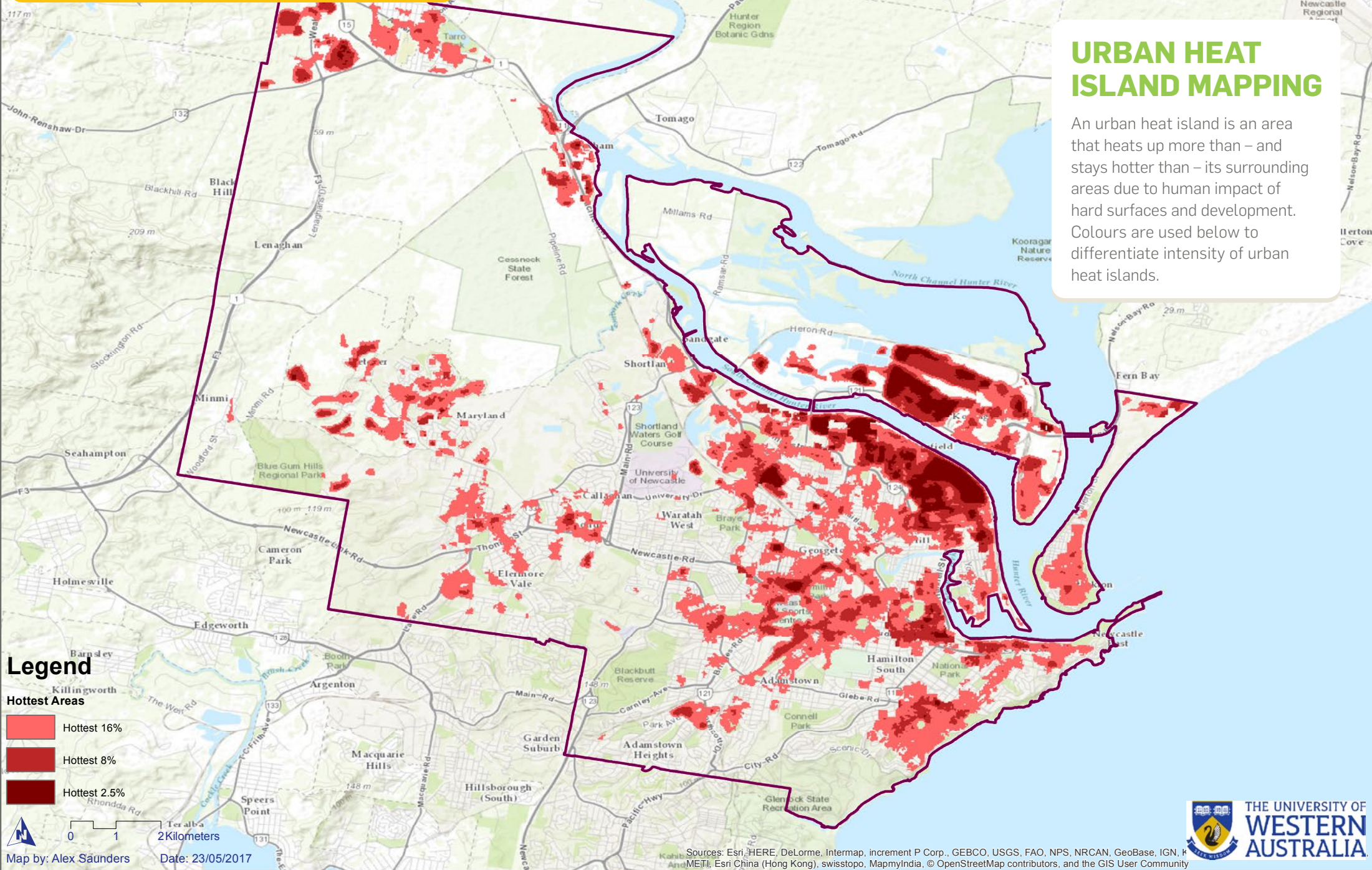




# NSW – NEWCASTLE

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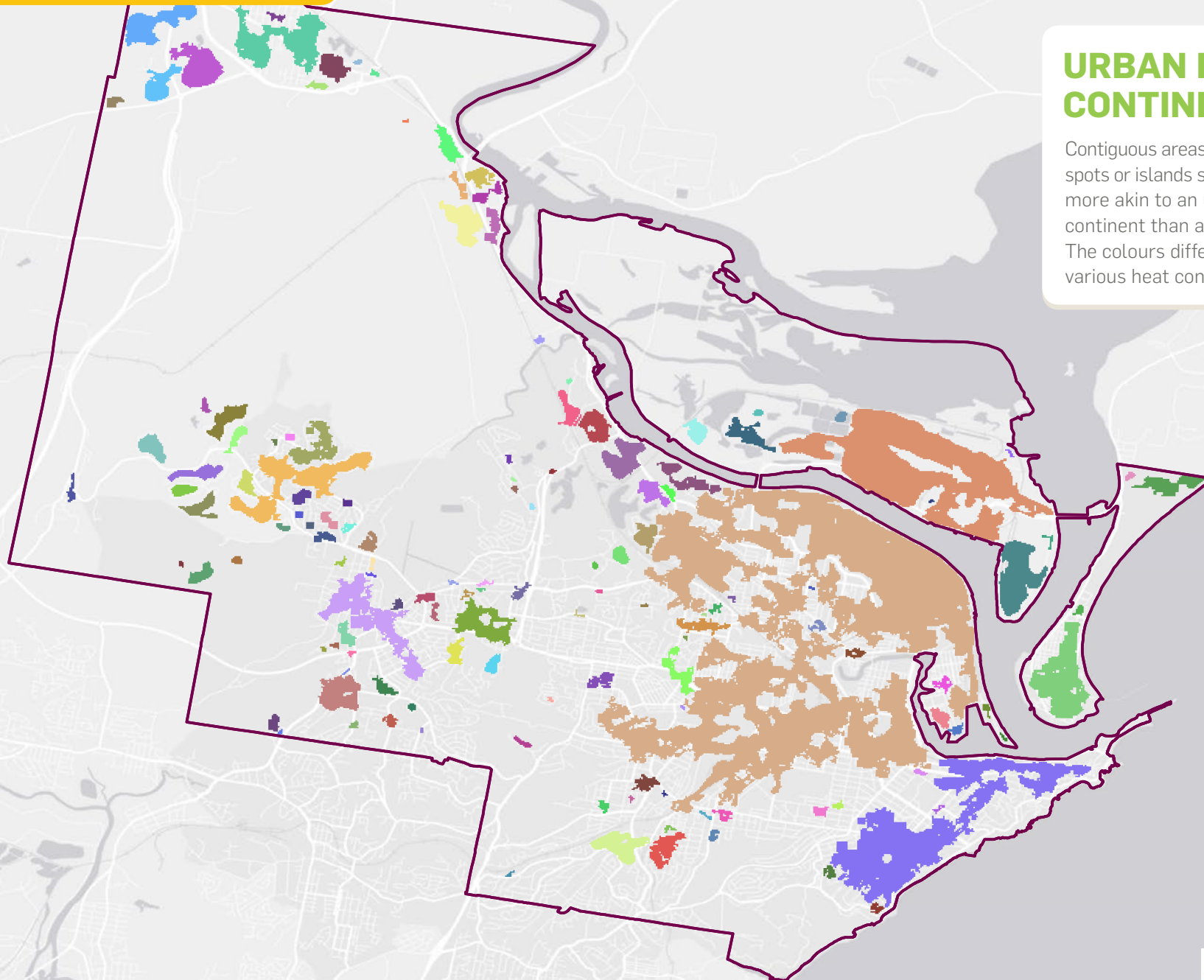




# NSW – NEWCASTLE

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.





*The best tree canopy gains have been made in Bankstown Council (4% gain) and the City of Sydney (3.6% gain).*





**NORTH SYDNEY COUNCIL**

Since 1997, North Sydney Council has strived to undertake regular detailed canopy analysis. LIDAR assessment in 2008 reported 34% canopy cover and in 2014, 31% canopy cover. There was no analysis in 2016 due to bad weather but the next round of measurement is due to be conducted in Spring 2017 and will be carried out in conjunction with City of Sydney. Once this additional data has been measured it will be incorporated into a review of the Urban Forestry Strategy which has been in place since 2011.

Currently, key greening opportunities are aligned with the snapshot findings and are focused in and around St Leonards – an area identified as a hotspot. North Sydney Council has been actively planting out carparks over the past five years, and has experienced good rates of tree growth. The North Sydney Council Urban Forest Strategy is accessible to the public via the website.

**MELISSA MCMANUS**

PARKS DEPARTMENT  
TECHNICAL OFFICE

**PENRITH CITY COUNCIL**

Using data from 2011 Penrith City Council undertook an in-depth study across the Penrith LGA. This analysis allowed us to identify priority areas to focus future urban greening and cooling projects. These areas are St Marys, Penrith, Kingswood, Cranebrook and Glenmore Park.

**CARMEL HAMILTON**

SUSTAINABILITY  
COORDINATOR

**SUTHERLAND SHIRE COUNCIL**

The snapshot should be read within a broader context to refine future action. For example, the intersection as a priority area is in fact quite treed in its local context. The heat detected is likely to be coming from the Miranda centre and large Westfield shopping centre on Kiara Road. Council has an active Green Streets Program designed to maintain tree canopy in the future in the face of increased densification.

The Green Streets Program seeks to grow the next generation of canopy trees in the public domain to offset those lost from private land with four new trees being planted for each tree removed in Sutherland Shire. Since 2012, over 7,000 trees have been planted in the public domain through this project. In Miranda centre, *Syncarpia glomulifera* have been planted in the Kingsway and species from the Sydney Turpentine Iron Bark Forest planted in surrounding streets.

**MARK CARLON**

MANAGER STRATEGIC  
PLANNING

**KARENNE JURD**

ASSET PROGRAM  
COORDINATOR, ENVIRONMENT  
INFRASTRUCTURE PLANNING

**NEWCASTLE CITY COUNCIL**

Overall, there is general alignment between the City of Newcastle's (Council) understanding of hotspots and what the RMIT mapping has identified. However, it should be noted that the analysis of hard sand that includes 'water' needs to be moderated in areas such as the Newcastle LGA, which comprises a substantial area of small and large wetlands. For example, the substantial constructed wetland at Sandgate needs to be incorporated in such analysis when projecting the performance of this light industrial area. As major hotspots identified in industrial areas are on private land, Council is working to build partnerships to address these hotspots through proactively targeting street tree planting such as the recent planting of the Beresfield light industrial areas.

Each year, as part of the annual Street and Park Tree Renewal Program, Council plants on average 1,100 trees. Approximately 90% of these are street trees, with the remaining planted within park open space. Council's approach to tree planting is a strategic one that takes into account our GIS tree asset inventory of 113,377 new and

established urban trees, our Urban Forest Policy (2008), Development Control Plans and Technical Guidance Manuals, maintenance schedules, community requests, water sensitive urban design, microclimate modifications and the location of tree vacancy sites across the LGA.

Council's potential planting areas include:

Merewether, The Junction – Corlette, Frederick, Kemp, Kilgour, Patrick and Buchanan Streets.

Mayfield East – whole suburb retrofit, and Stevenson Park, Mayfield West.

Kotara – Parkway Avenue and Howell Street, Kulliah Reserve

Beresfield – Local Centre, Beresford and Landor Street.

Wallsend – Local Centre, Wallsend Reserve and road rehabilitation sites.

Hamilton – Denison and Samdon Streets.





# VICTORIA





Average canopy cover  
for urban VIC is

**18.83%**

down 2.06% from

**20.89%**

in 2009.



There has been an  
overall increase of

**3%** in hard

surfaces, which is  
exactly the same  
rate of increase as  
NSW, but overall  
VIC has around

**5%** less hard  
surfaces than NSW.



In VIC, **44%** of urban LGAs have  
undergone a significant loss of tree canopy,  
with only **8%** having had a significant  
increase in shrubbery.

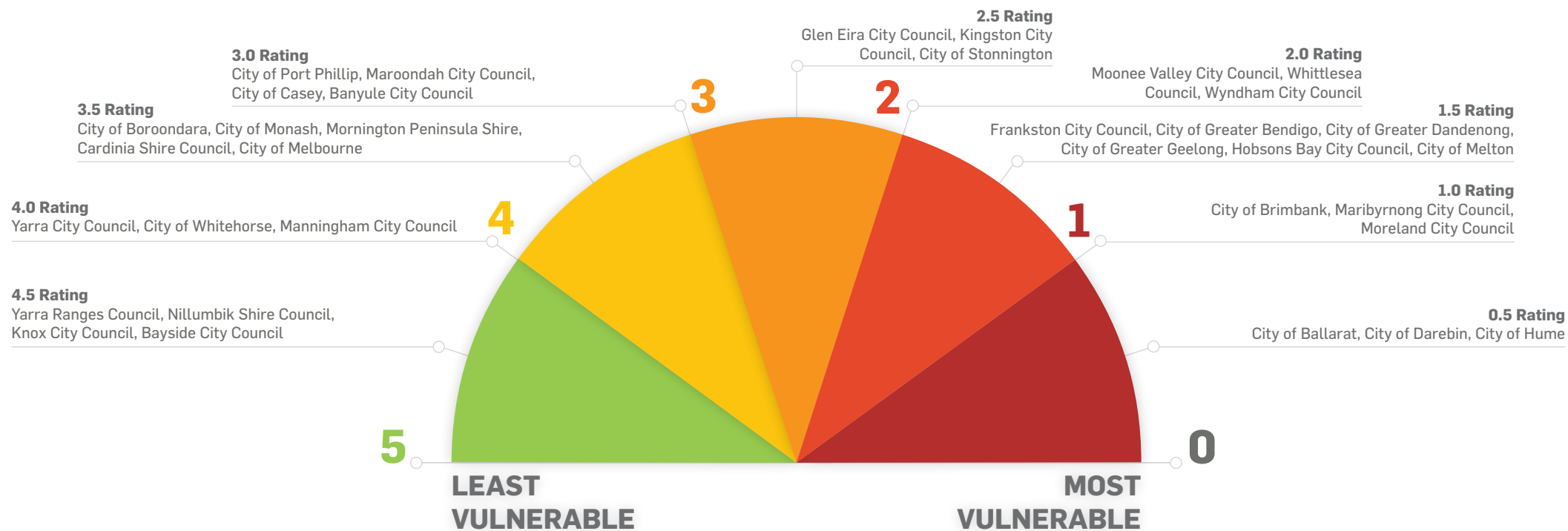


## THERE HAVE BEEN QUITE A FEW SIGNIFICANT CANOPY LOSSES.

– Notably in the City of Ballarat (5%), Banyule City Council (4.6%), Cardinia Shire Council (5.9%), Nillumbik Shire Council (12.8%), Maroondah City Council (4.7%), Mornington Peninsula Shire (4.7%) and Eira City Council (4.8%).







### TOP URBAN GREENING OPPORTUNITIES:

- City of Ballarat, City of Darebin, City of Hume (0.5)
- City of Brimbank, Maribyrnong City Council, Moreland City Council (1)
- Frankston City Council, City of Greater Bendigo, City of Greater Dandenong, City of Greater Geelong, Hobsons Bay City Council, City of Melton (1.5)
- Moonee Valley City Council, Whittlesea Council, Wyndham City Council (2)



## THE GREEN KEY

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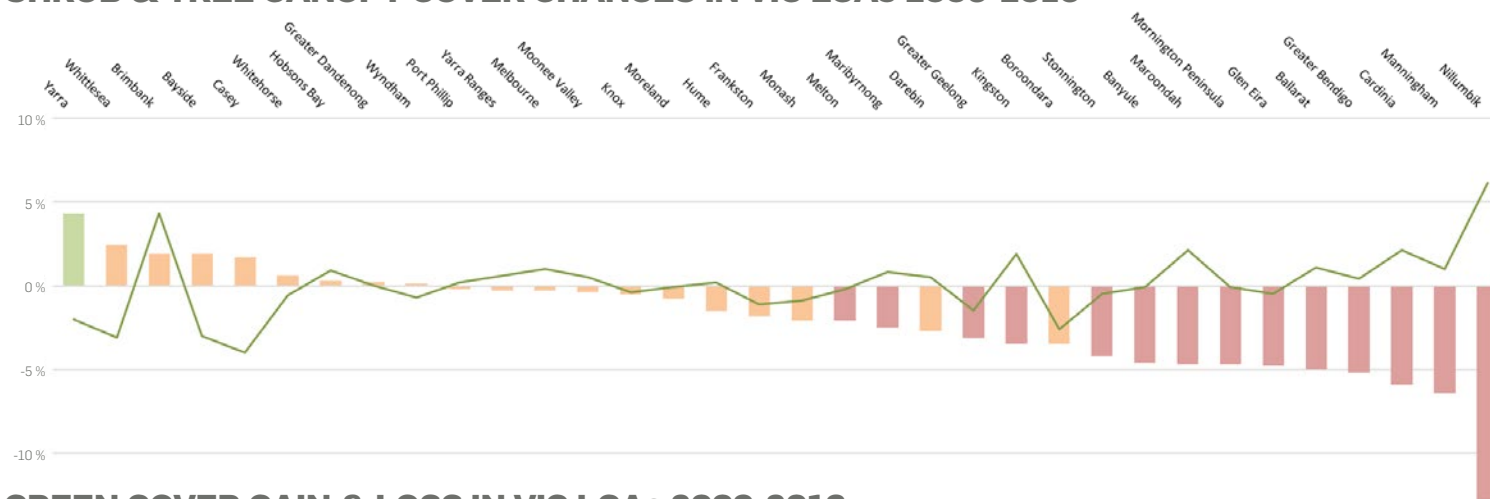


### Hard surfaces

Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	20.89%	18.83%	2.06% Loss
Shrub Cover	4.82%	4.89%	0.07% Gain
Grass Cover	40.04%	39.03%	1.01% Loss
Hard Surface	34.25%	37.26%	3.01% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN VIC LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN VIC LGAs 2009-2016



\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)



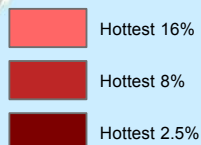
# VIC – MELBOURNE

## URBAN HEAT ISLAND MAPPING

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### Legend

#### Hottest Areas



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

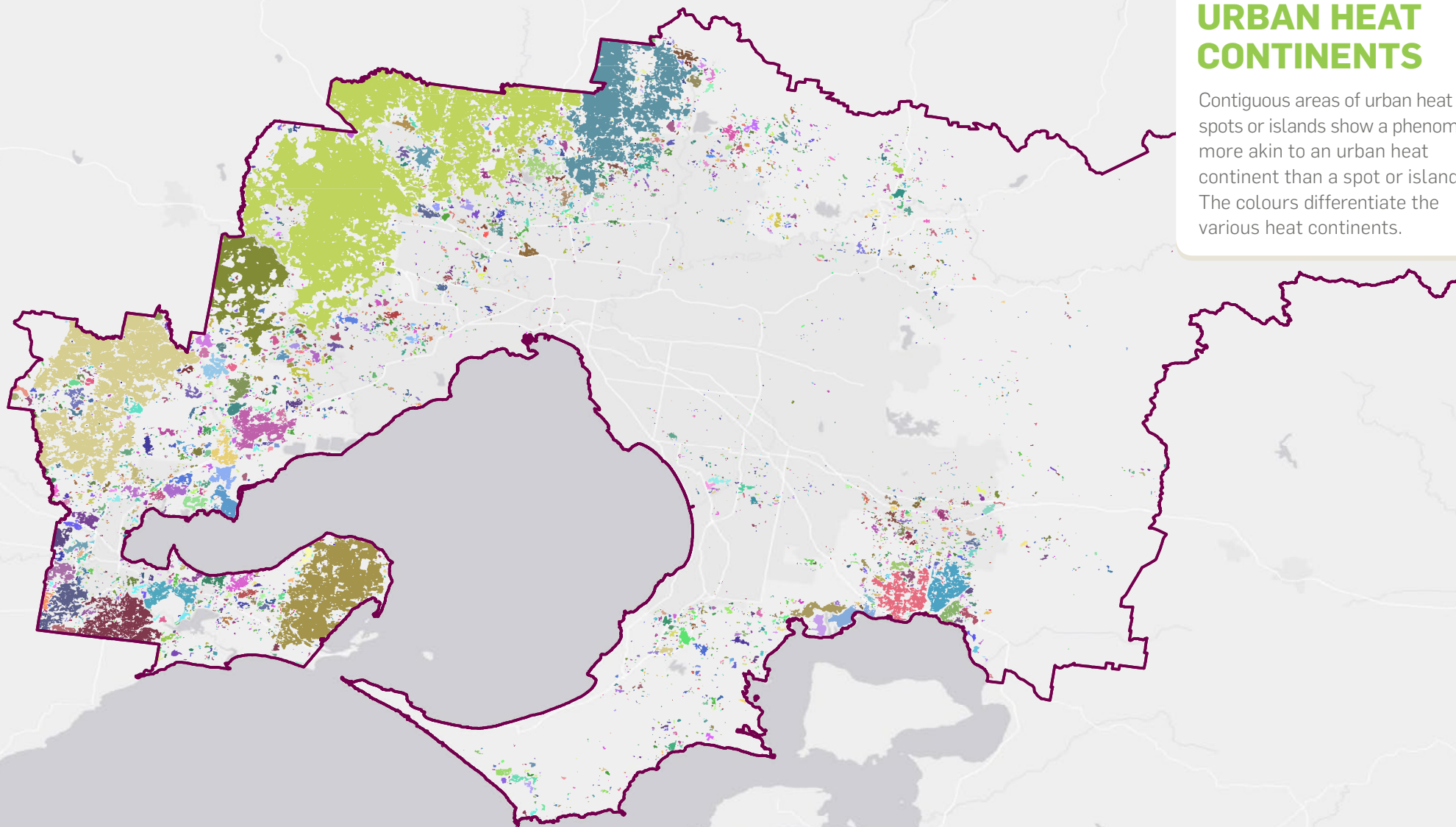


THE UNIVERSITY OF  
WESTERN  
AUSTRALIA



## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



0 10 20 Kilometers



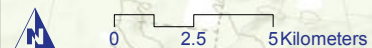
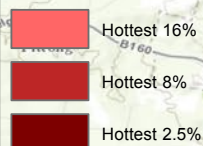
# VIC – BALLARAT

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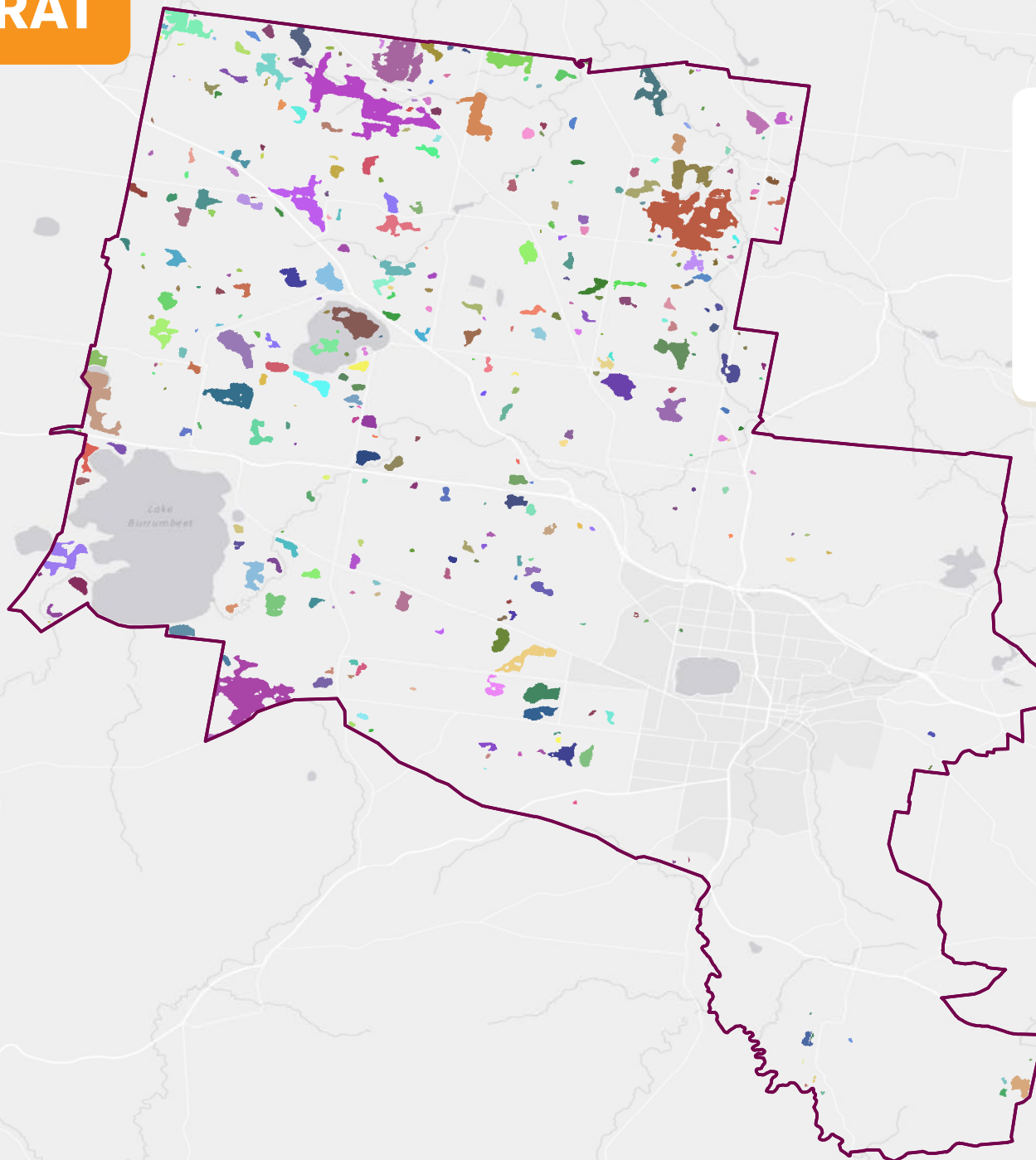
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# VIC – BALLARAT

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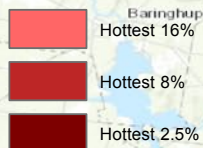
# VIC – BENDIGO

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### Legend

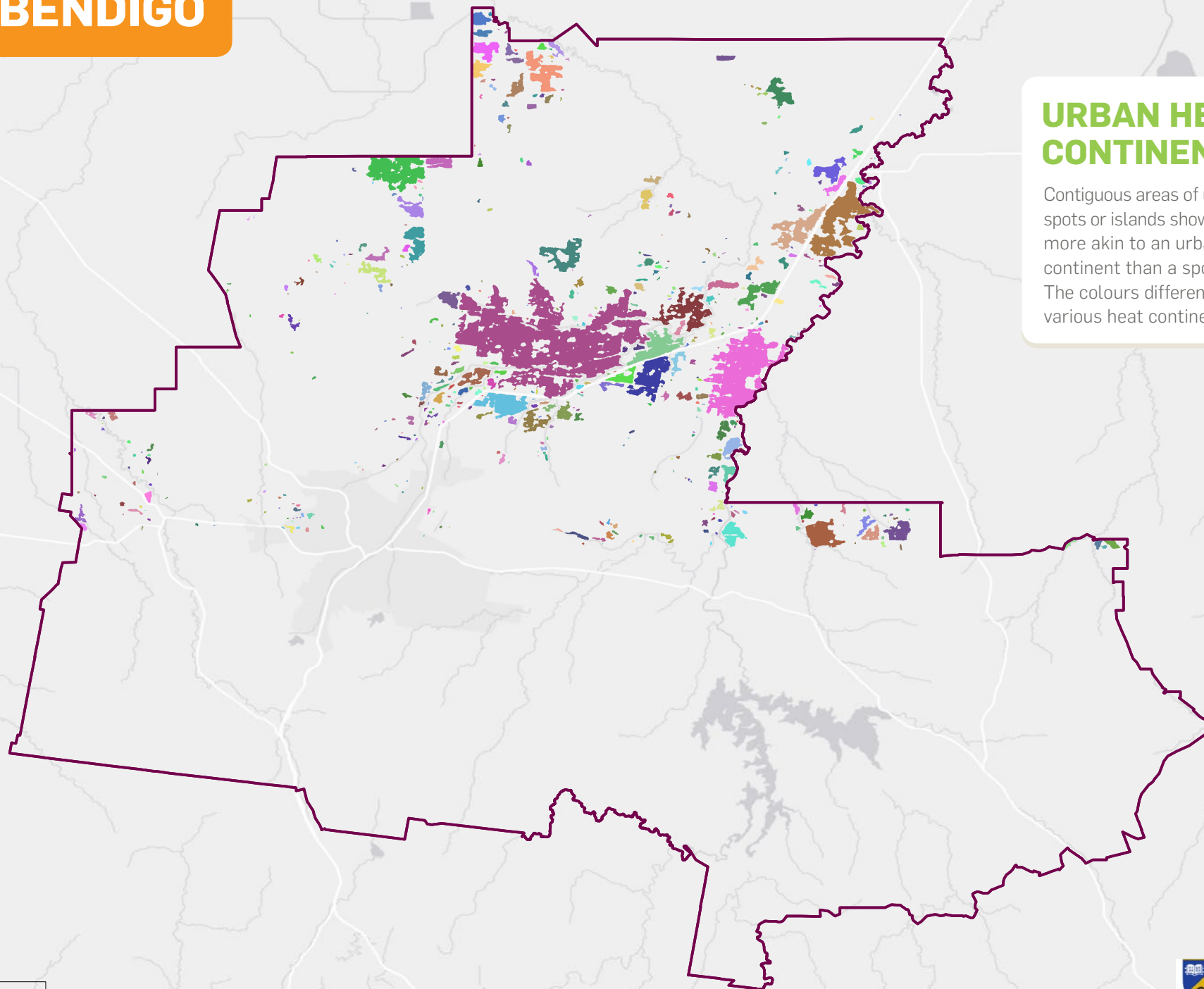
#### Hottest Areas





## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



0 5 10 Kilometers







*Despite population growth and an increase in hard surface areas, the City of Melbourne has managed to maintain its canopy levels – there has been no significant loss of canopy.*

*Given Ballarat's vulnerability and overall loss of canopy there is a significant urban greening opportunity there. However it is likely that these results are somewhat of an anomaly given that Ballarat has higher than average areas of pastoral land and is somewhat atypical of other urban LGAs.*

*The City of Yarra has gained 4.3% in canopy cover and has a longstanding commitment to urban forestry.*

**MORNINGTON PENINSULA SHIRE**

**JESSICA WINGAD**  
MANAGER CLIMATE  
CHANGE, ENERGY  
AND WATER

*The Mornington Peninsula Shire is located Southeast of Melbourne and is surrounded by the coast on three sides. We note that the hotspots and areas of vulnerability are generally outside of our urban growth boundary or not located in our most heavily populated areas. One interpretation of these results is that the lack of or change in vegetation may be due to horticultural or recreational development.*

**FRANKSTON CITY COUNCIL**

*The City of Frankston has limited data on canopy cover and this is the first we've seen about hotspots and heat, so it is of great interest to us. Interestingly, the heat mapping showed that the hotspots were in our rural, not urban areas, so there was limited overlap between where vulnerable people live and where it is hottest.*

*We would be interested in learning more about where our canopy cover is being lost.*

**NATHALIE NUNN**  
ENVIRONMENTAL  
PLANNER

**WYNDHAM CITY COUNCIL**

*Roughly 58% of the Wyndham municipality is outside the Urban Growth Boundary.*

*Rural areas are dominated by market gardens and the Western Grassland Reserve which protects natural temperate grasslands of the volcanic plains, a critically endangered ecosystem where trees are naturally scarce.*

*The low tree canopy percentage of the entire municipality reflects this and there are very few locations where dense tree planting is appropriate within the rural area. Urban Wyndham has a much higher tree canopy cover however due to tree planting within the urban growth zone. The rapid population growth means there is a large portion of young trees, as well as many vacant sites where additional trees can be planted within streets and parks.*

**BENJAMIN DE KLEPPER**  
URBAN FOREST PLANNER



**CITY OF GREATER BENDIGO****TANIA MACLEOD**PROJECT OFFICER  
ARBORICULTURE

Bendigo's urban growth boundary covers only 4.2% (126 km<sup>2</sup>) of the Greater Bendigo Local Government area (3000 km<sup>2</sup>), therefore canopy cover statistics for the urban area are quite different than those for the entire LGA, with large proportions of agricultural land and national, state and regional parks. Bendigo is often referred to as the 'City in a Forest,' attributed to the ring of Box Ironbark forest (Greater Bendigo National Park) which almost encircles the urban area.

A canopy cover analysis (using iTree canopy) of Bendigo's urban area (defined by the urban growth boundary) paints a very different picture than the statistics supplied in your report for the entire Greater Bendigo area. Tree canopy here is 19% compared to 28% from the 2014 assessment. Impermeable surfaces cover over a quarter of all land compared to only 3% over all of Greater Bendigo.

This is predicted to get worse as Bendigo develops, expands into new growth areas and infill existing urban areas. We are also predicted to lose 44% of all city trees over the next 10 years as our ageing European trees come to the end of their natural lives.

**MAROONDAH CITY COUNCIL**

We realise that this is a broad brush analysis, but observe that the areas identified as greening opportunities due to the high temperatures are mostly intensively developed industrial areas, shopping centre car parks and the like. In terms of public greening, our current opportunities are limited to areas that council has control of, such as nature strips. Although it may seem challenging, the real opportunity is for there to be more green infrastructure such as green roofs and walls within private locations, which we would encourage.

**RICHARD PHILLIPS**TREE MANAGEMENT  
OFFICER





# QUEENSLAND





Average canopy cover in urban QLD is the highest in the country at

**47.2%**  
down 3% from

**50.2%**  
in 2009.



The rate of loss in QLD is almost  
**DOUBLE**  
that of any other state.



**40%**

of urban LGAs have had no significant loss or increase in canopy.



The increase in hard cover is most pronounced in the City of Brisbane where that gain seems to have come largely at the expense of grassed areas. However there is a significant increase of

**3.3%** in shrubbery which, based on trends seen in other QLD LGAs, would predict a canopy increase over time.



There has been a  
**1.65%**

increase in shrub cover and a small

**0.49%**  
reduction in grass.

Hard surface areas have increased by

**1.79%**



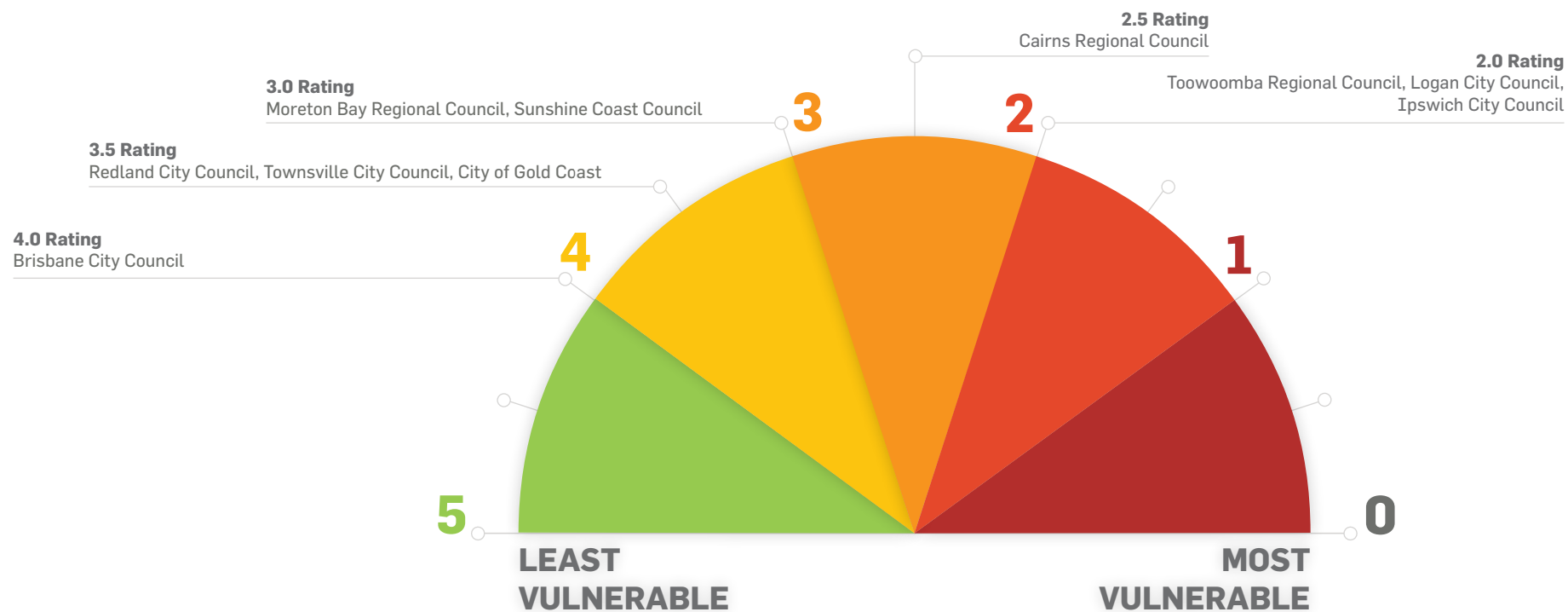
The **8.9%** loss in canopy in Redland City Council should be watched because at the same time there has been a

**3.5%** increase in hard surfaces and a

**4%** increase in grassed areas.

There has not, however, been a significant increase in shrubbery, indicating that there may not be enough small saplings and trees being planted to compensate for the loss of canopy.





### TOP URBAN GREENING OPPORTUNITIES:

- Toowoomba Regional Council, Logan City Council, Ipswich City Council (2)
- Cairns Regional Council (2.5)
- Moreton Bay Regional Council, Sunshine Coast Council (3)





## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

Anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



### Shrub

Landscaped vegetation as well as bushland shrubs, crops and grapevines.



### Grass

Cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.

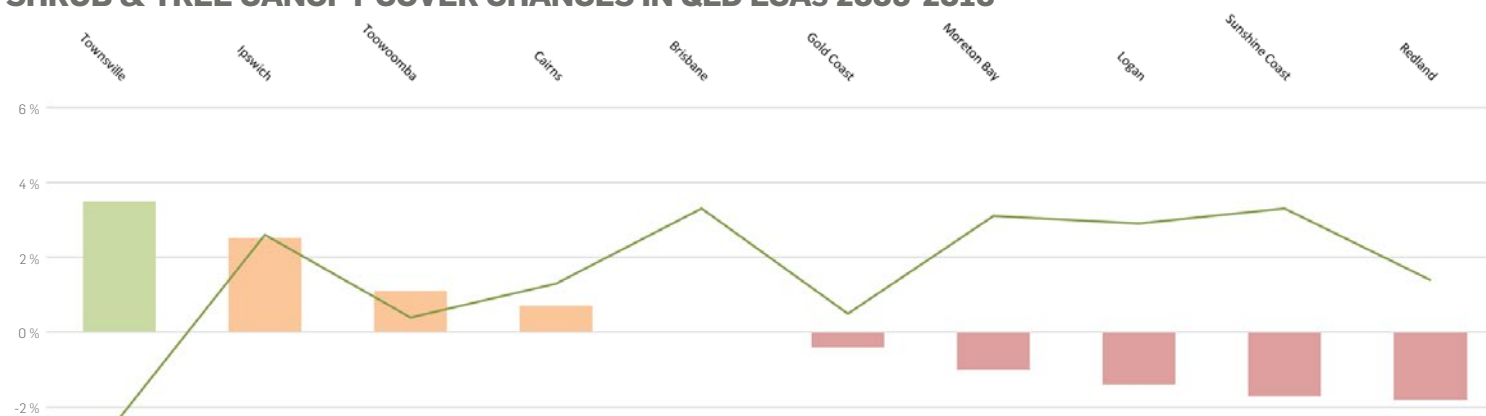


### Hard surfaces

Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	50.2%	47.2%	3% Loss
Shrub Cover	6.69%	8.34%	1.65% Gain
Grass Cover	35%	34.51%	0.49% Loss
Hard Surface	8.11%	9.9%	1.79% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN QLD LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN QLD LGAs 2009-2016



SIGNIFICANT INCREASE

NO SIGNIFICANT CHANGE

SIGNIFICANT DECREASE

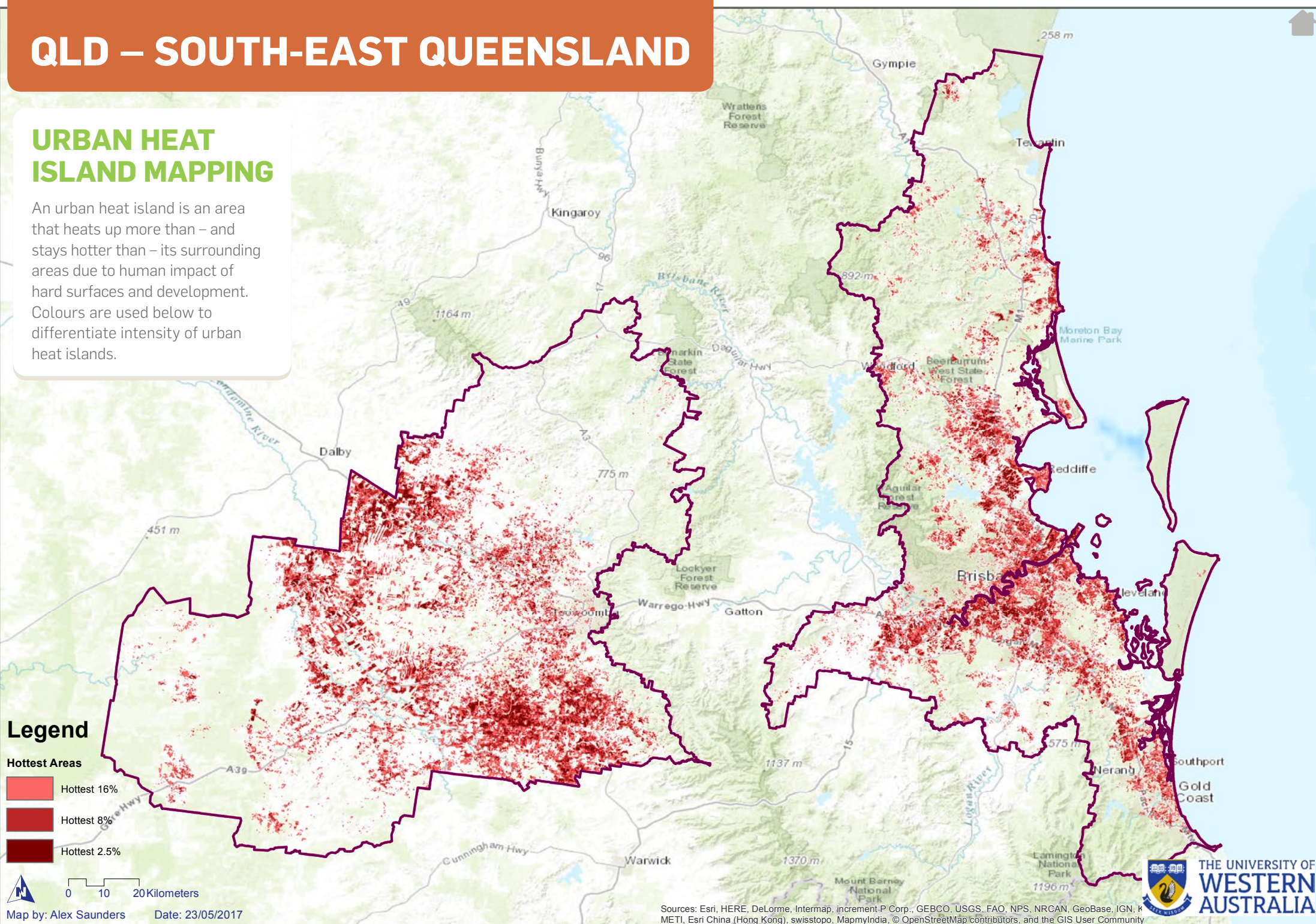
SHRUB CHANGE

\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)

# QLD – SOUTH-EAST QUEENSLAND

## URBAN HEAT ISLAND MAPPING

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas due to human impact of hard surfaces and development. Colours are used below to differentiate intensity of urban heat islands.

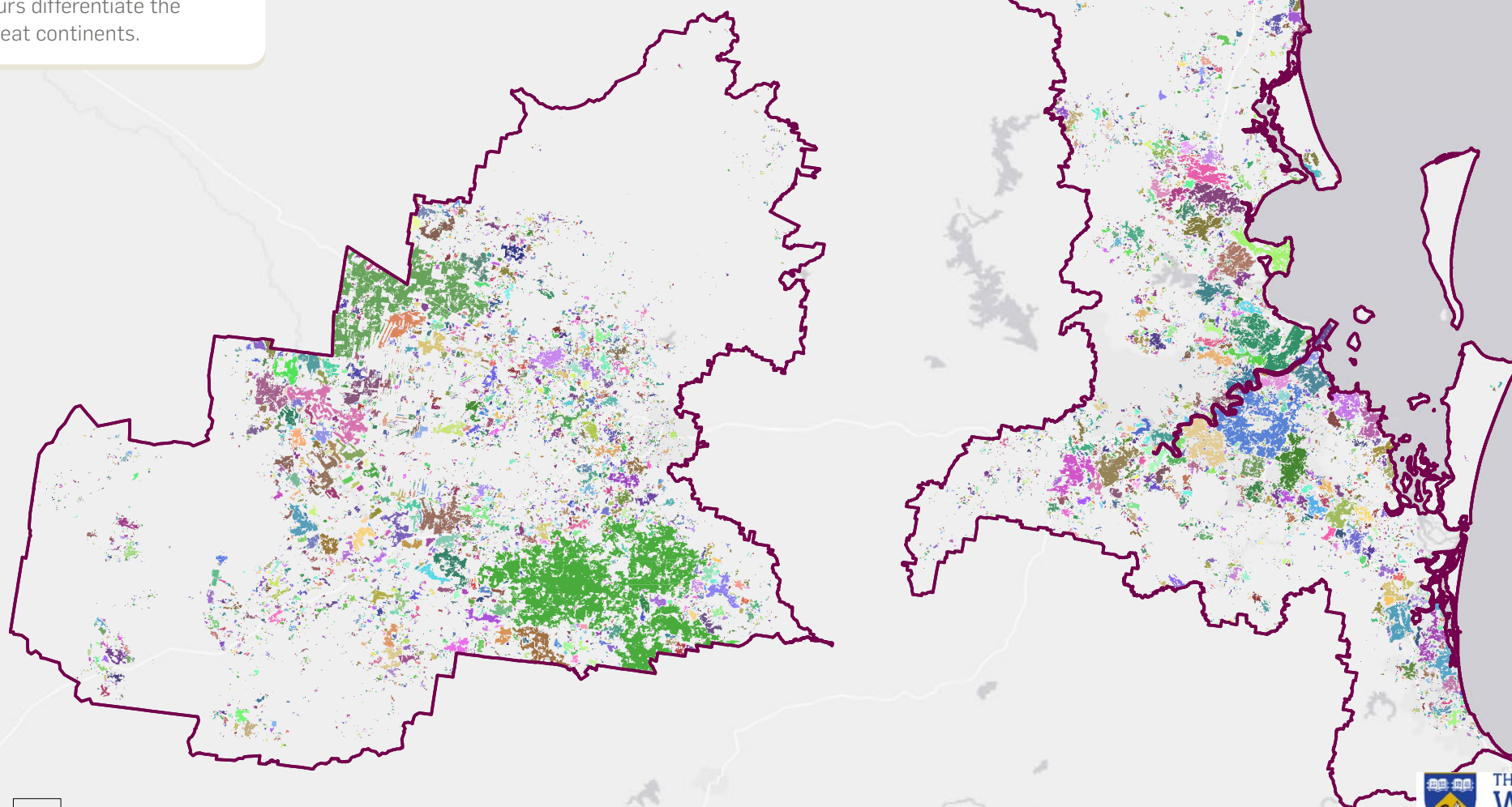




# QLD – SOUTH-EAST QUEENSLAND

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



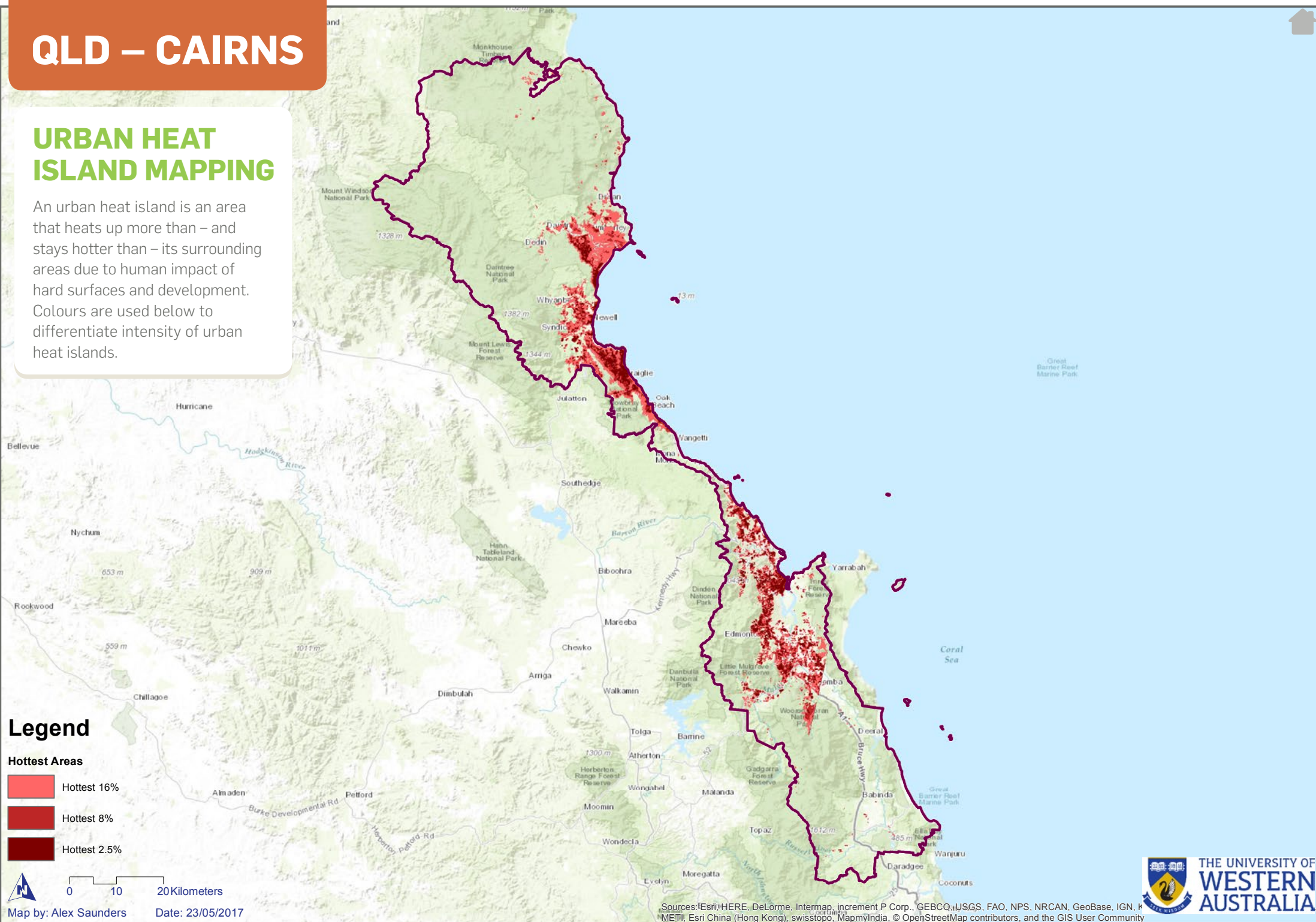
0 10 20 Kilometers



# QLD – CAIRNS

## URBAN HEAT ISLAND MAPPING

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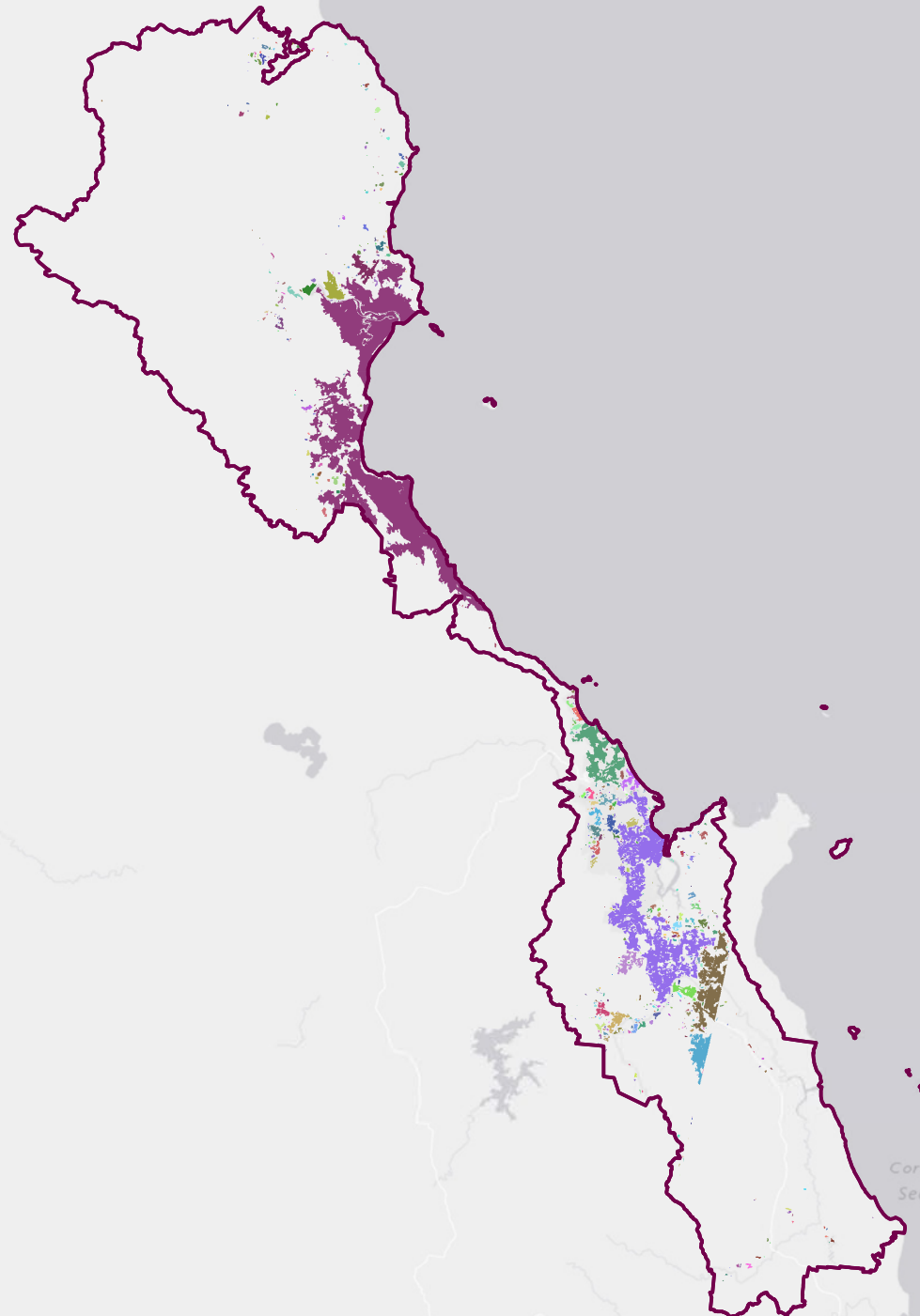




# QLD – CAIRNS

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



0 10 20 Kilometers

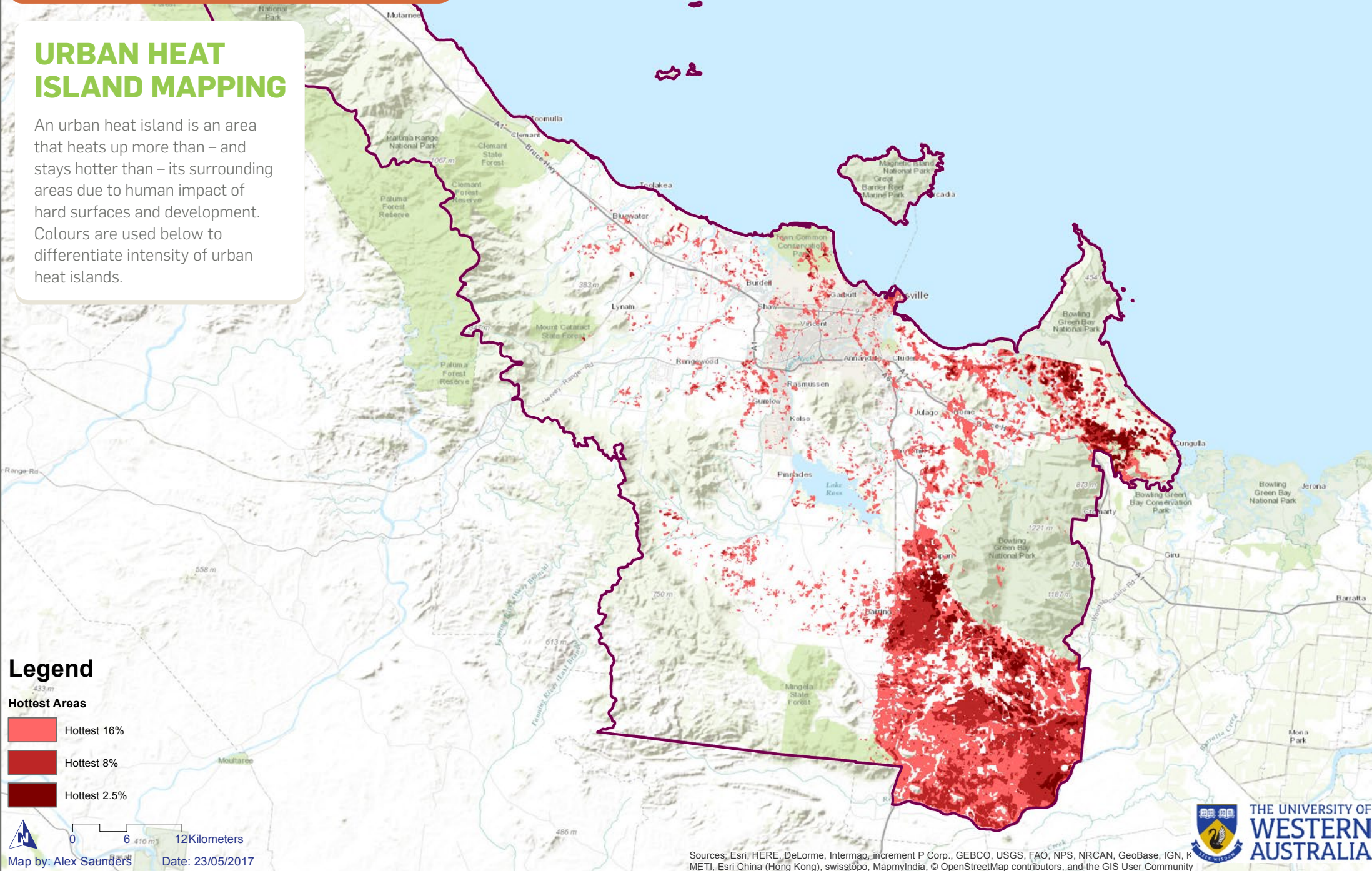
Map by: Alex Saunders

Date: 23/05/2017

# QLD – TOWNSVILLE

## URBAN HEAT ISLAND MAPPING

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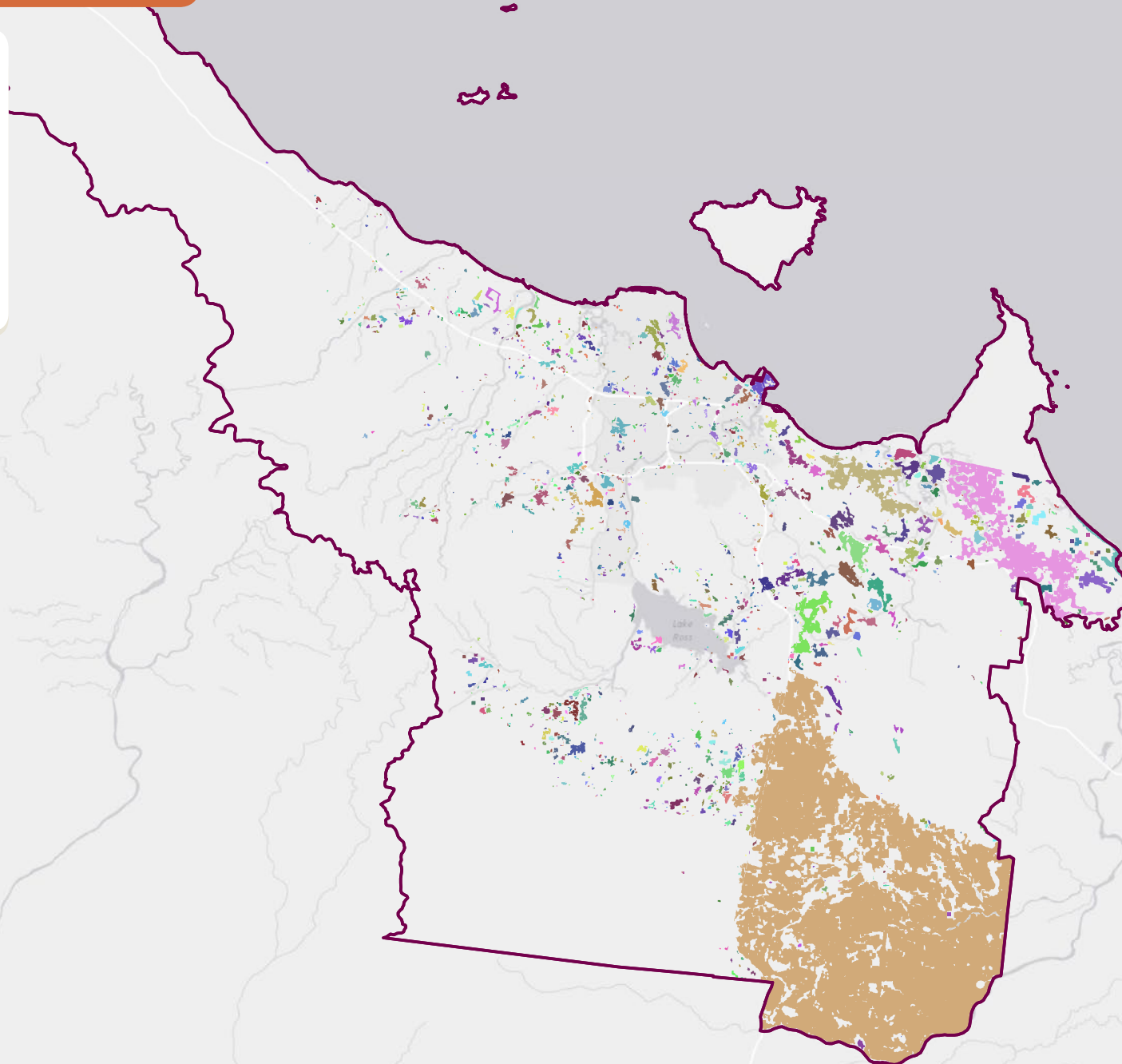




# QLD – TOWNSVILLE

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.





*Overall, the state's VHHEDA Index rating is 2.9%, making it one of the least vulnerable states to health risks associated with urban heat incidences.*

*Townsville has undergone a 10% gain in canopy, much of which seems to be a result of grassed (down 9.4%) and shrub-covered (down 2.3%) surfaces maturing and being recognised by analysts as canopy.*

*In the City of Brisbane, there is a significant increase of 3.3% in shrubbery which, based on trends seen in other LGAs, would predict a canopy increase over time.*

*In Logan City, the 8.2% loss in canopy appears not to have been to hard surfaces but instead to a combination of grassed and shrub-covered surfaces.*

*Based on trends elsewhere in QLD, this would likely signify that over time this grassed area might convert to shrubs and the 2.9% shrubbery cover to convert into canopy to compensate for the 8.2% loss.*





## TOOWOOMBA REGIONAL COUNCIL

**CALLUM EDWARDS**  
SENIOR ARBORIST

*The urban heat island mapping for a rural local government (like Toowoomba Regional Council) is somewhat misleading and hard to apply. Land mapped in the Toowoomba LGA and shown as hotspots is either natural grasslands or agricultural land.*

*I agree these land types need to be mapped and considered when discussing vegetation cover. However, it may be best to have two different maps (in a perfect world) – one showing the extent of the LGA (including the agricultural and grassland) and associated hotspots, and the other showing urban areas (as defined by planning schemes/instruments). From a management viewpoint, this would provide more useable information for strategy and policy development. I do understand this would be a time consuming process.*

## REDLAND CITY COUNCIL

*It is important to acknowledge that this report includes data from both the mainland and the islands, specifically North Stradbroke Island, a forested area that is in fact larger than its mainland counterpart and is currently in the process of becoming a National Park. This inclusion skews the data in a positive way, not necessarily reflecting the reality of our Redlands urban areas.*

**CANDY DAUNT**  
SENIOR ADVISOR,  
ENVIRONMENT POLICY  
AND PLANNING

## BRISBANE CITY COUNCIL

*Brisbane City Council has recently released 'Brisbane: Clean, Green, Sustainable 2017-2031'. Chapter 8 (the Urban Forest) outlines Council's goal to value, nurture and protect its urban forest. Council is committed to identifying the hot parts of the City with low tree cover in order to target tree plantings in areas that require shade and cooling. Council will consider the locations and opportunities identified in 'Where should all the trees go?' and their suitability for planting. The strategy also identifies two landmark projects including urban cooling and a memorial ring of green.*

**KRISTEN DANGERFIELD**  
URBAN FOREST  
PROGRAM OFFICER

## CITY OF GOLD COAST

*Generally speaking the identified hotspot areas seem to correspond to the urban footprint, with some of the hottest areas aligning with suburbs we expect would be subject to additional urban heat i.e. the City's northern suburbs.*

*Unfortunately at this mapping scale it is difficult to confirm and ideally we would overlay the outputs with our urban footprint and other GIS layers to provide a true comparison. To date we have not produced heat mapping for the City so are unable to compare with a similar dataset.*

**SAMANTHA BONNEY**  
SUPERVISOR OF NATURAL  
HAZARDS





# SOUTH AUSTRALIA





Average canopy cover  
for urban SA is

**19.45%**

down 1.92% from

**21.37%**

in 2009.



**79%** of the  
urban LGAs in SA are  
rated as vulnerable on  
our VHHEDA Index.



**NO COUNCIL**

has had a significant  
gain in urban tree  
canopy cover.



**43%** of urban  
LGAs have had a  
significant loss in tree  
canopy cover.



The City of Playford appears to be  
the most vulnerable LGA in the state.

It only has **9.4%** canopy  
cover and has undergone a loss of

**5.4%** since 2009, in  
combination with a loss of shrubbery

and a **4.5%** increase in hard  
surfaces. It is rated as one of the  
most vulnerable LGAs in the country.



**36%**  
of urban LGAs  
have had a  
significant  
increase in hard  
surfaces, on  
average this  
increase has been  
by **5%**

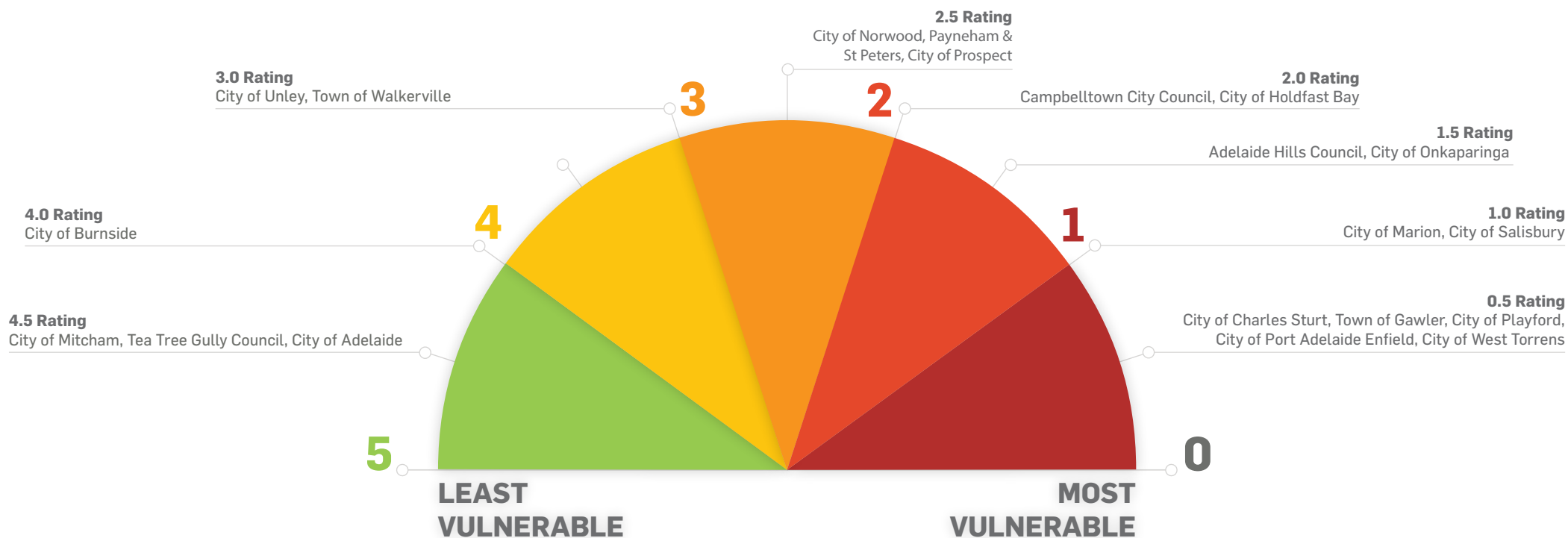


The loss of grassed  
surfaces by

**10.9%**

in the City of  
Burnside, and the  
gain in shrubbery  
would suggest  
some greening.





### TOP URBAN GREENING OPPORTUNITIES:

- City of Charles Sturt, Town of Gawler, City of Playford, City of Port Adelaide Enfield, City of West Torrens (0.5)
- City of Marion, City of Salisbury (1)
- Adelaide Hills Council, City of Onkaparinga (1.5)
- Campbelltown City Council, City of Holdfast Bay (2)
- City of Norwood, Payneham & St Peters, City of Prospect (2.5)
- City of Unley, Town of Walkerville (3)





## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

Anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



### Shrub

Landscaped vegetation as well as bushland shrubs, crops and grapevines.



### Grass

Cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.

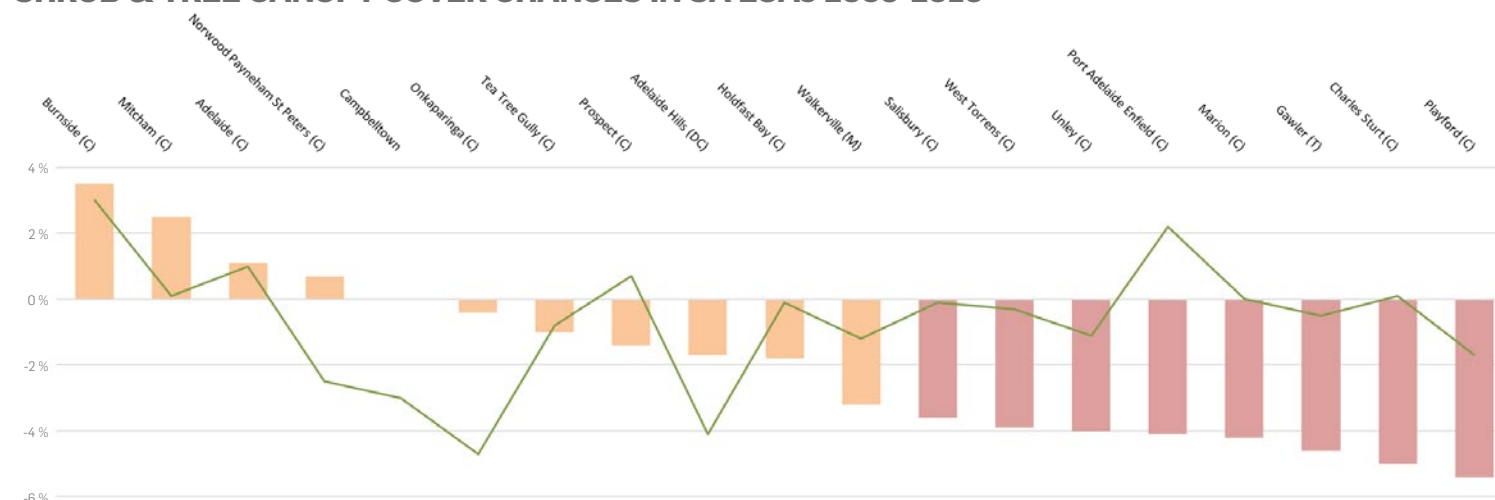


### Hard surfaces

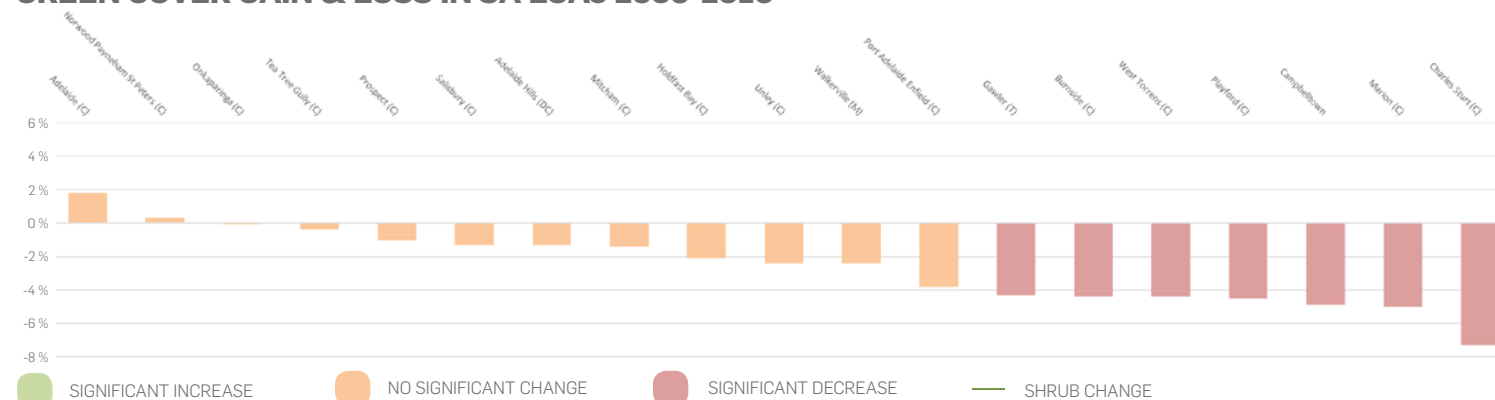
Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	21.37%	19.45%	1.92% Loss
Shrub Cover	5.92%	5.23%	0.69% Loss
Grass Cover	32.08%	32.1%	0.02% Gain
Hard Surface	40.63%	43.2%	2.57% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN SA LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN SA LGAs 2009-2016



\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)

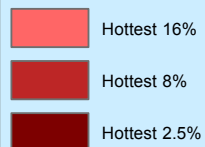
# SA – ADELAIDE

## URBAN HEAT ISLAND MAPPING

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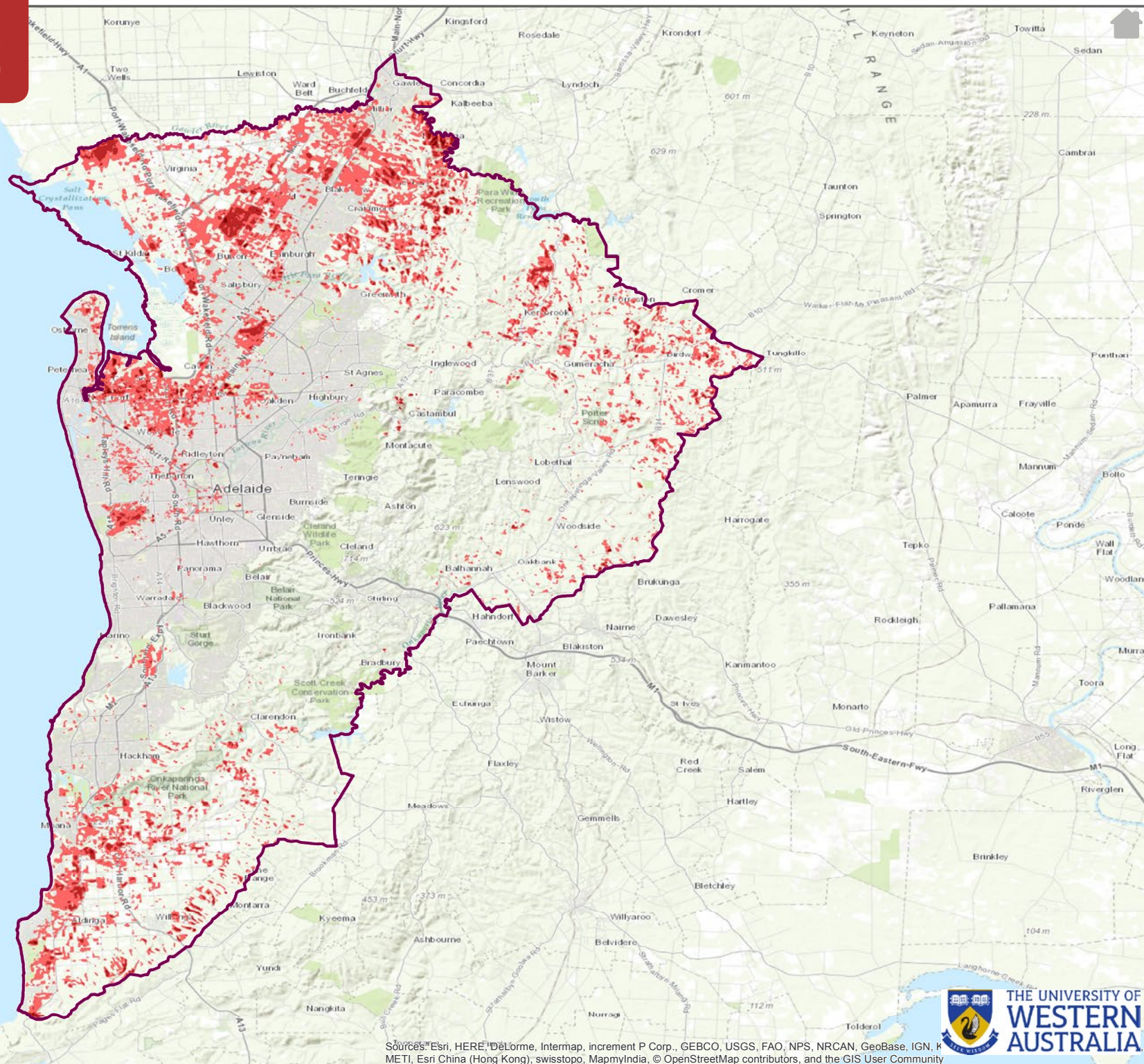
### Legend

#### Hottest Areas



0 5.5 11 Kilometers

Map by: Alex Saunders Date: 23/05/2017



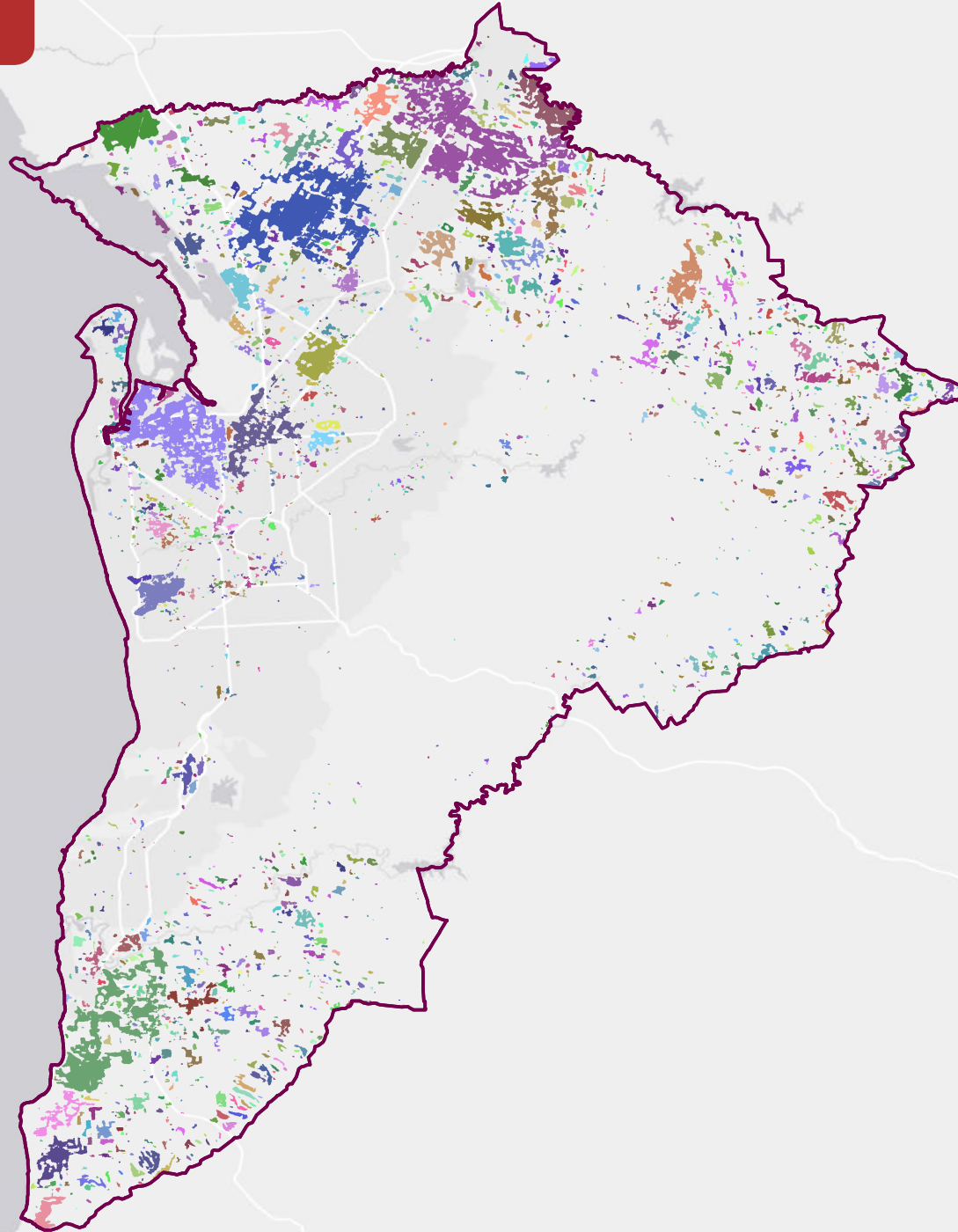
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



# SA – ADELAIDE

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



0 5.5 11 Kilometers

Map by: Alex Saunders

Date: 23/05/2017



*Despite being the most densely populated part of SA, the City of Adelaide's canopy cover of 21.4% (up by 1.1% from 2009 figures), has the 8th best canopy cover of the 19 urban LGAs.*



*Despite a significant loss of grassed surfaces, the City of Burnside has gained 3% shrub cover.*





### CITY OF WEST TORRENS

*The City of West Torrens (with the University of South Australia) undertook an i-tree Canopy assessment in 2017 and came up with slightly different results to those in the RMIT report. Notably a 2.3% loss of canopy, compared to the 3.9% on the snapshot and a 1.6% increase in impervious surfaces, compared to the 4.9% increase reported by RMIT. Based on our sample we would be in the 'no significant change' category.*

*We are currently undertaking detailed heat mapping which will be available in due course.*

### CAMPBELLTOWN CITY COUNCIL

*The snapshot seems in keeping with our observations. The City has experienced a notable increase in subdivisions since the baseline data. In 2016, there were 340 new allotments created and in 2015 there were 329. This compares to only 179 new allotments in 2014.*

*Much of the loss in green cover is on private land and unfortunately this is something we have little control over. Across all of Campbelltown's suburbs, Council data suggests an average 6% decrease in tree canopy cover from 2006 to 2016.*

*Therefore the key statistic for tree canopy cover that says "no change" in the snapshot appears misleading – it doesn't seem to align with the VHHEDA Index rating of 2 (a figure that does seem in keeping with our observations).*

**NICKY O'BROIN**

SUSTAINABILITY PLANNER

### CITY OF ONKAPARINGA

*The City of Onkaparinga undertook high-resolution multispectral airborne image collection for heat and canopy in February 2016, however this was for our urban area only.*

*Our urban canopy cover varied from the RMIT snapshot, and instead we recorded tree canopy cover of 12.5% and overall vegetation cover of 24.8%. Our definition of a tree was over three metres as this is the height at which cooling can begin to be attributed.*

*The heat mapping is difficult to compare as our focus was on urban areas only and not the entire LGA. In terms of vulnerability this would appear to us to be consistent with our understanding of the area, particularly considering that the 12.5% tree canopy cover is one of the lowest rates I've encountered.*

*One of the key challenges is that our LGA is peri-urban and consequently the rural areas skew findings for tree canopy – this would happen favourably or unfavourably depending on land use. In our LGA, land is used for vineyards, cropping and horticulture whereas in others there may be mainly national parks.*

**JENNI MCLENNON**

SUSTAINABILITY  
COORDINATOR, STRATEGIC  
FUTURES

**HENRY HAAVISTO**

TREE MANAGEMENT  
OFFICE

**CITY OF PORT ADELAIDE ENFIELD**

**MAGGIE HINE**  
ACTING MANAGER CITY  
DEVELOPMENT

*Since the data was collected for this snapshot, the City of Port Adelaide Enfield, along with their partners in the Adapt West Climate Change Adaptation Program (Cities of West Torrens and Charles Sturt with the support of the Adelaide Mount Lofty Ranges Natural Resources Management Board), have undertaken urban heat mapping of the region. The councils have also undertaken further i-tree assessments. The findings from Adapt West's more localised assessment are due to be released in late 2017. These localised assessments will provide more detailed information to help identify where green infrastructure might be placed.*

**CITY OF PROSPECT**

*The areas that have been identified in the heat map are consistent with our data because they are either areas with a shopping centre or vacant land. Currently, the land on the north-west corner of our council area is being developed and will most definitely include vegetation and street tree planting.*

*We have also increased our budget for our Street Tree Planting program in the last year and this is consistent with the Council Strategic Plan indicating increased tree canopy cover. We have a Green Neighbourhoods program running that is specifically looking at streets of poor tree canopy cover as we aim to achieve a 'green tunnel' canopy cover for all streets. Currently this has been captured through looking at a minimum of 70% tree canopy cover. We have identified that the laneways do not achieve this and will be difficult to achieve as they are so narrow.*

**NINA PHILLIPS**  
LANDSCAPE ARCHITECT





# WESTERN AUSTRALIA





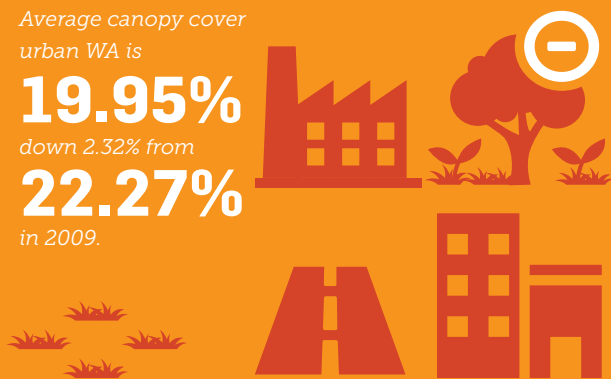
Average canopy cover  
urban WA is

**19.95%**

down 2.32% from

**22.27%**

in 2009.



**51%** of  
urban LGAs in  
WA have seen a  
decrease in shrubs.



**41%** of

urban LGAs in WA  
have experienced a  
significant loss  
in canopy.



**24%** of  
LGAs in WA have  
seen an increase  
in hard surfaces.



The City of Cockburn  
is of concern given that  
there has been a

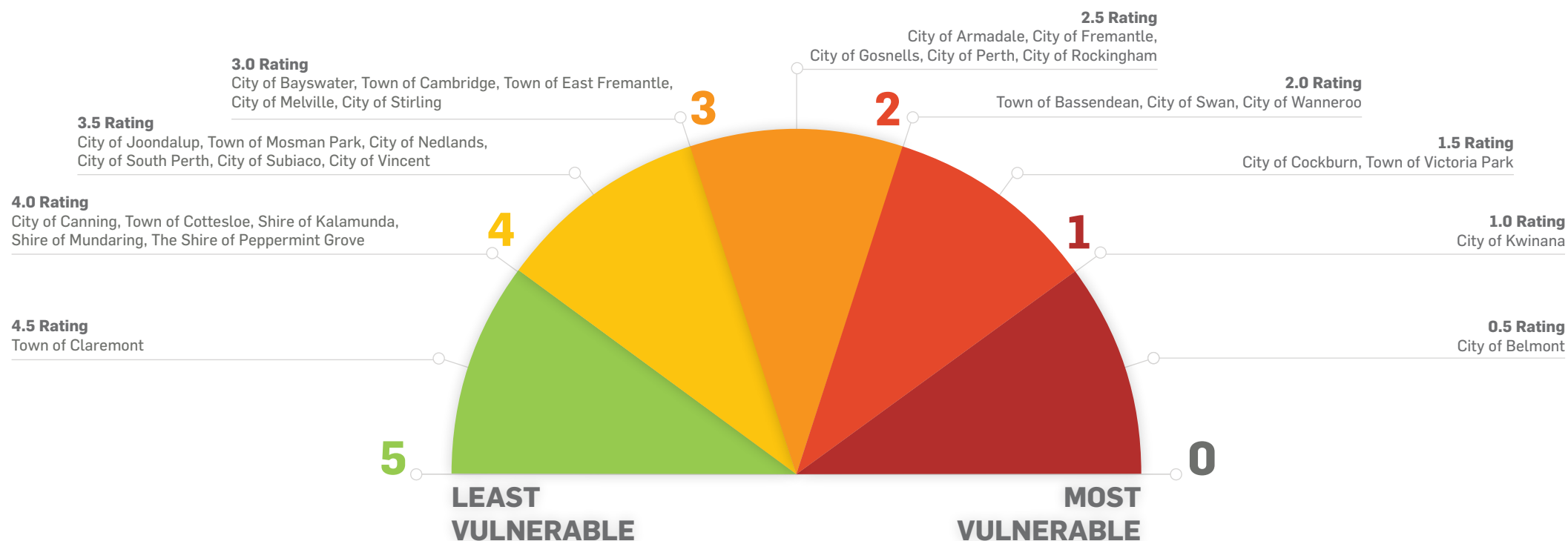
**16.6%** loss

in shrubbery and an almost  
equivalent gain in grass  
surfaces, suggesting that  
clearing may have taken place.



The **5%** loss of canopy in the City of Cockburn is  
almost equivalent to that of the hard surface increase.





### TOP URBAN GREENING OPPORTUNITIES:

- City of Belmont (0.5)
- City of Kwinana (1)
- City of Cockburn, Town of Victoria Park (1.5)
- Town of Bassendean, City of Swan, City of Wanneroo (2)
- City of Armadale, City of Fremantle, City of Gosnells, City of Perth, City of Rockingham (2.5)
- City of Bayswater, Town of Cambridge, Town of East Fremantle, City of Melville, City of Stirling (3)



## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

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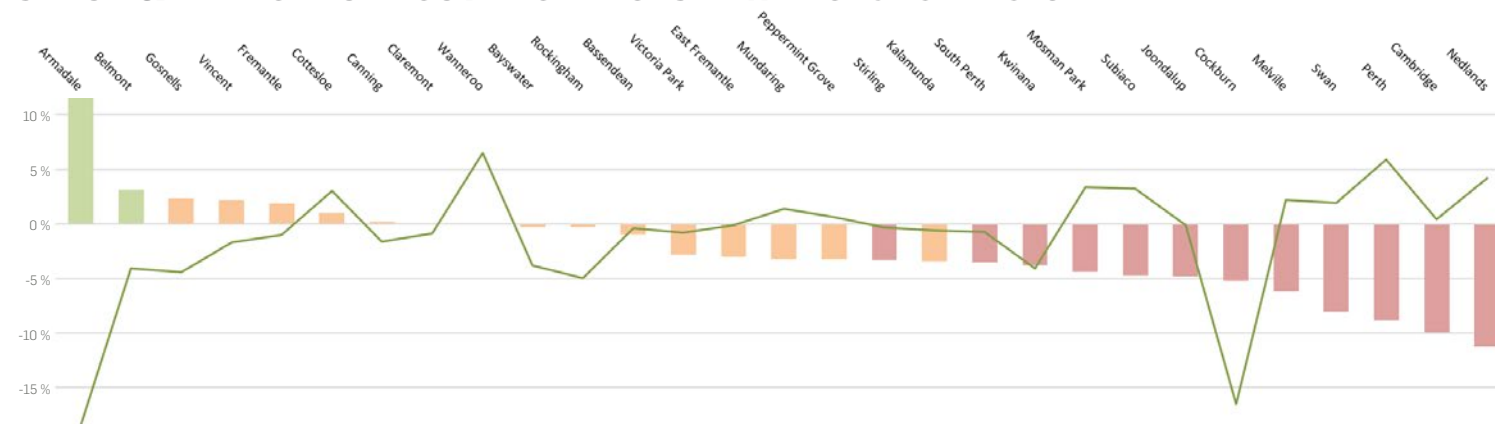


### Hard surfaces

Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	22.27%	19.95%	2.32% Loss
Shrub Cover	8.73%	7.63%	1.1% Loss
Grass Cover	29.87%	31.19%	1.32% Gain
Hard Surface	39.13%	41.22%	2.09% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN WA LGAs 2011-2016



## GREEN COVER GAIN & LOSS IN WA LGAs 2011-2016



\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)



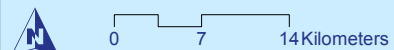
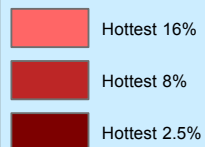
# WA – PERTH

## URBAN HEAT ISLAND MAPPING

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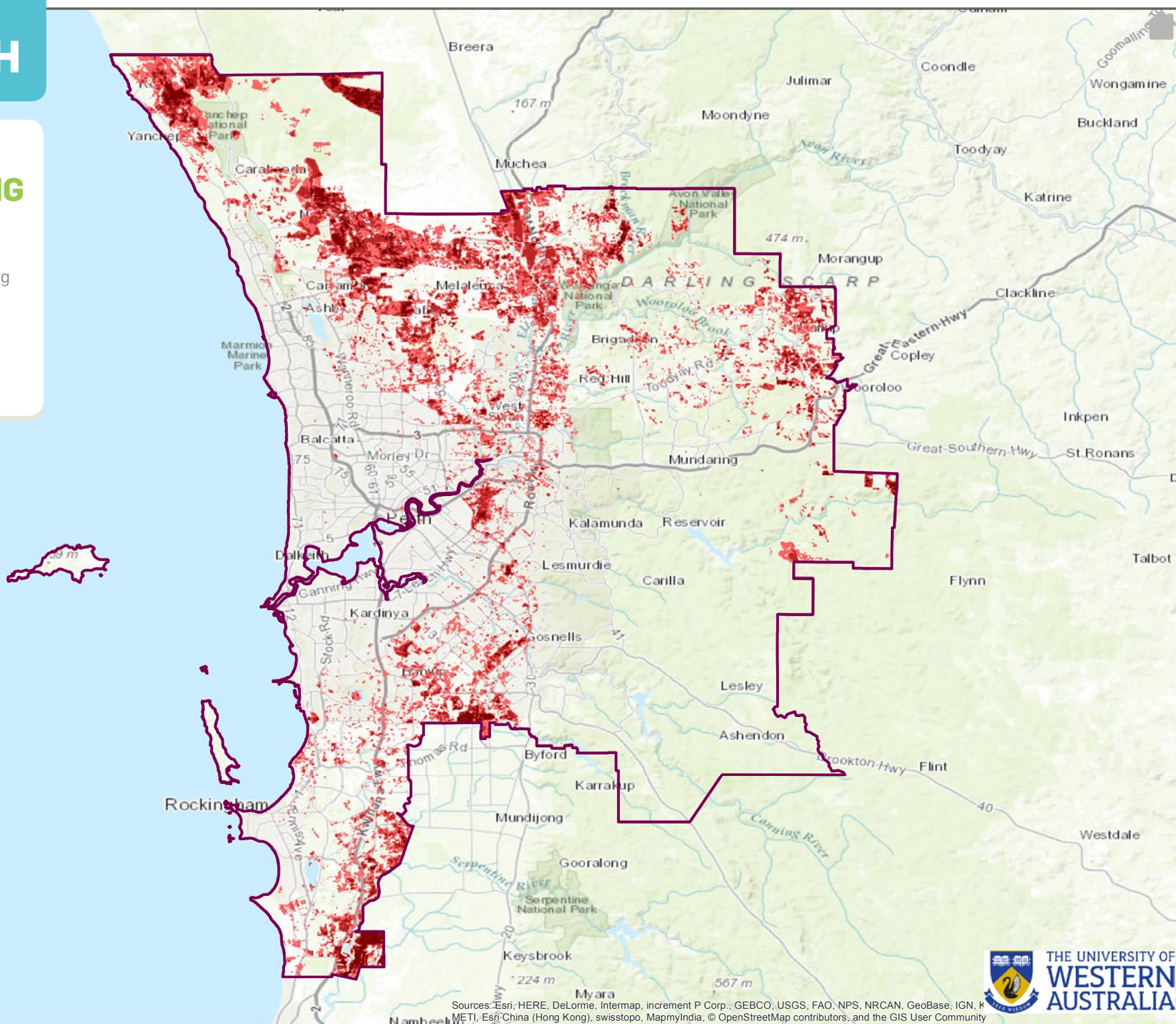
### Legend

#### Hottest Areas



Map by: Alex Saunders

Date: 23/05/2017



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

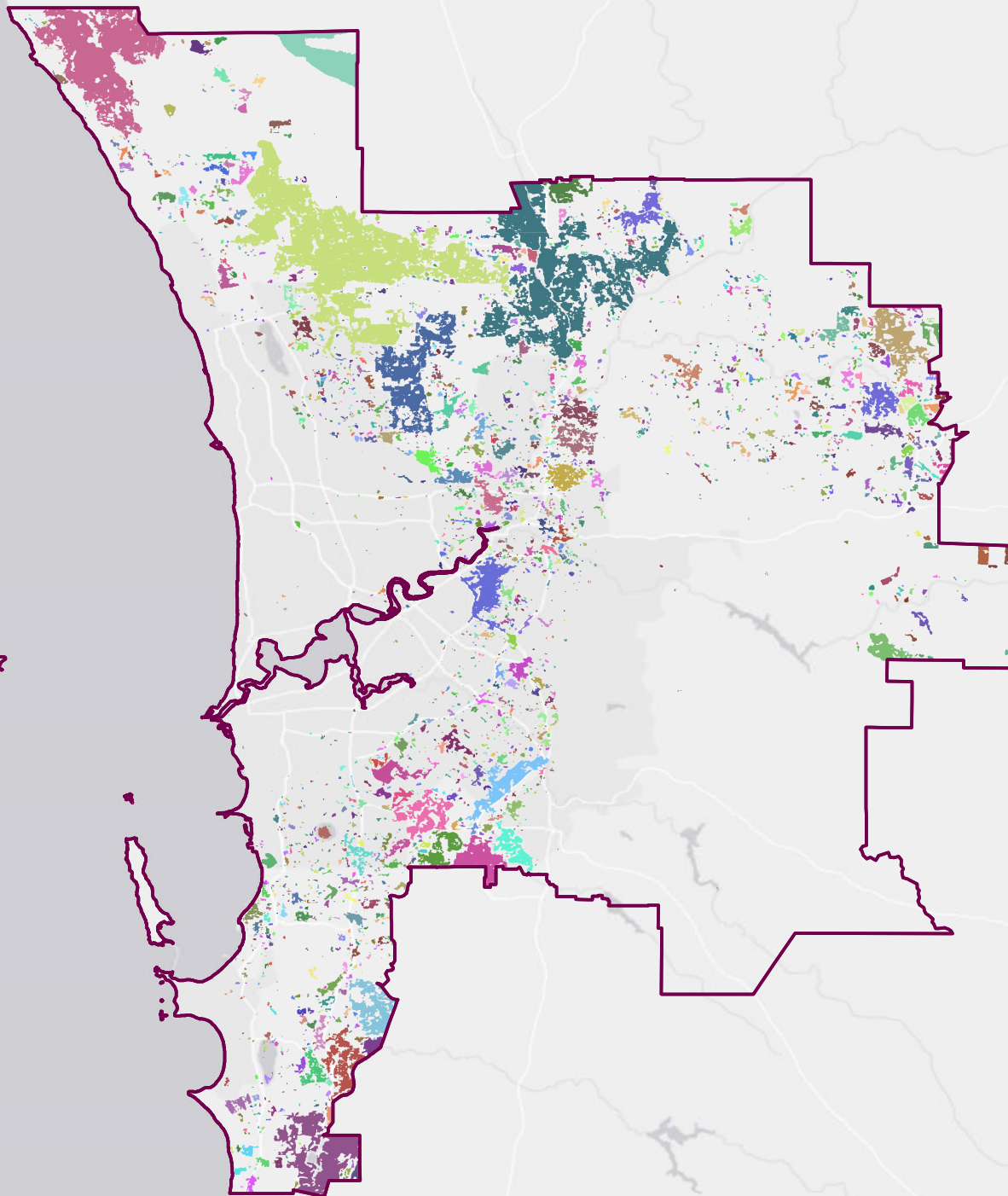


THE UNIVERSITY OF  
WESTERN  
AUSTRALIA

# WA – PERTH

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.



0 7 14 Kilometers

Map by: Alex Saunders

Date: 23/05/2017





The City of Armadale currently has

## 46% URBAN TREE CANOPY COVER

– the second highest cover among urban LGAs in WA.



The City of Armadale has undergone a

## 13.2% INCREASE IN CANOPY.

Hard surfaces have had no significant increase.

Grassed surfaces have increased by

## 6%

Shrub-covered areas have decreased by

## 18.4%

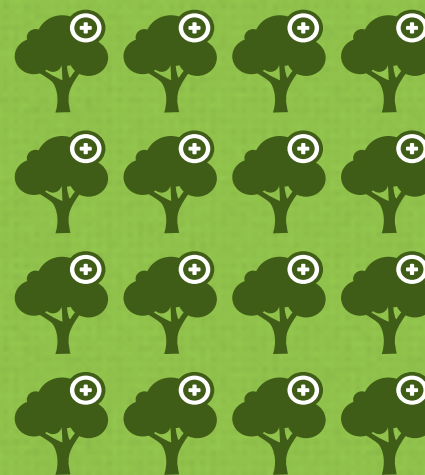
This low incidence of shrubbery is most likely due to smaller plantings maturing and now being identified as tree canopy.



The City of Belmont has also undergone an

## INCREASE IN TREE CANOPY BY 3.1%

This is particularly important as it has happened at the most vulnerable end of the scale (0.5).



Both the City of Belmont and the City of Armadale are two of

## THE MOST DEDICATED COUNCILS TO URBAN FORESTRY,

with strong targets and committed urban forestry teams.





## CITY OF SUBIACO

*The City of Subiaco has more detailed thermal imagery to identify heat islands and future planting areas that relates to its new town planning scheme. A more detailed strategy will be outlined in their new urban forest strategy by the end of 2017.*

**GRAY STEAD**  
MANAGER OPERATIONS  
AND ENVIRONMENT

## CITY OF VINCENT

*Our team has looked at the RMIT report for our LGA and we have found nothing that contradicts our expectations. We are yet to receive our own set of canopy data for the period in question, which means that we have not had the opportunity to compare RMIT's findings to our own dataset.*

*By way of comment, we found it interesting that all the areas of heat vulnerability and greening opportunity identified in the RMIT report for our LGA are on State Government controlled land, where we have little if any influence on plantings. We can however use the information to advocate to State Government, particularly as we had already identified those areas as a priority for greening.*

**ANITA MARRIOTT**  
SUSTAINABILITY OFFICER,  
POLICY & PLACE

## CITY OF KWINANA

*This is the first heat mapping data the City has had access to for our Local Government area. It will be useful for an upcoming review of our Climate Change Mitigation and Adaptation Strategy.*

*We feel the map is broadly accurate given our experience on the ground. It was noted that there are a few vegetated areas that are classified as hotspots. One large one in particular we noted had been burnt recently and wondered if this had affected the results. There is also another spot that is adjacent to Bollard Bulrush wetland and we wondered if the black soil may have affected this.*

*There is a large suburb (Bertram) that is undergoing a street tree planting program as it has very little vegetation. Given the lack of street trees in this suburb, it was surprising that this was not a hotspot. Belgravia is noted as a hotspot which matches our understanding of street tree coverage. There are other areas that are noted as hotspots that were recently cleared. It would be interesting to see how they change after urban development.*

**SARAH MCCABE**  
SUSTAINABILITY OFFICER

## REDLAND CITY COUNCIL

*This information is not accurate/granular enough to be of much use to the City of Darwin. We have conducted several studies related to managing urban heat with trees/green spaces and have work progressing in this area.*

**MICHAEL BRUVEL**  
MANAGER CLIMATE  
CHANGE & ENVIRONMENT





# TASMANIA





Average canopy cover  
for urban TAS is

**44.7%**

down 9.1% from

**53.8%**

in 2009.



Despite having the highest  
canopy cover, Tasmania  
has the highest average rate  
of canopy loss in the  
country, with the average  
loss across all urban  
LGAs being

**9.1%**

This is particularly  
pronounced in the denser  
urban areas of Launceston  
and Hobart.



The biggest loss has  
been in Glenorchy City  
Council with

**17%**

lost. This is the  
most significant  
loss of canopy in  
the country but is  
largely thought  
to be due to the  
2013 and 2016  
Tasmanian bushfires.

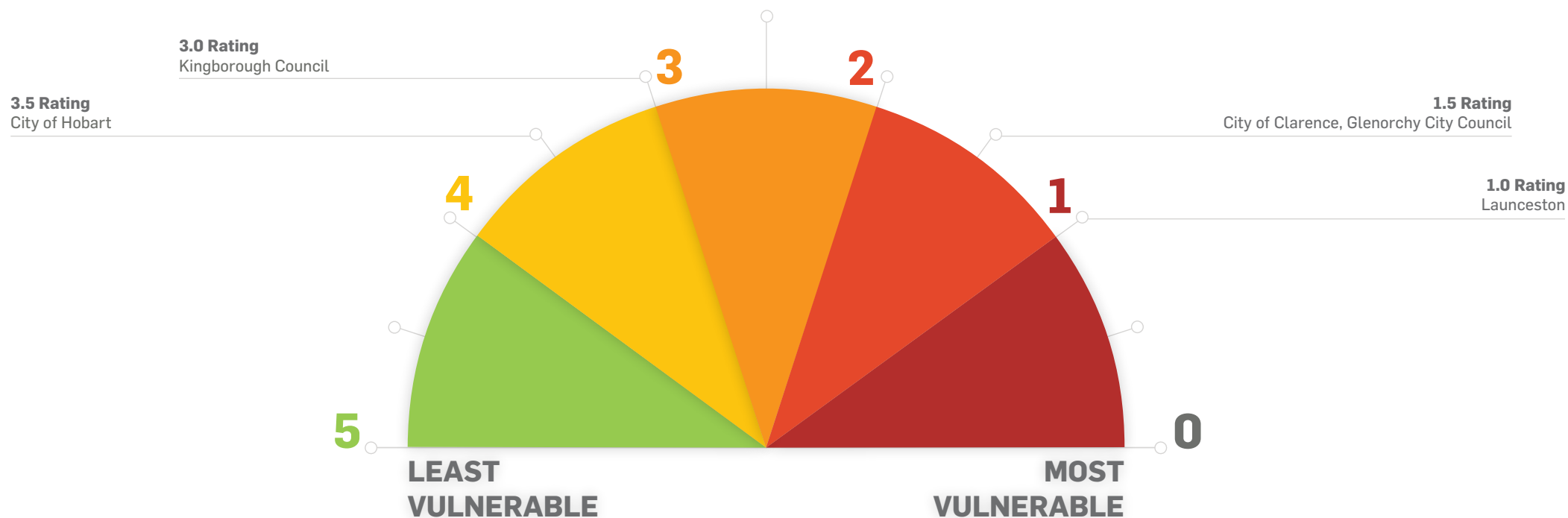


The **12.4%**

increase in shrubbery  
has in part  
compensated for this  
loss of canopy.







### TOP URBAN GREENING OPPORTUNITIES:

- City of Launceston (1)
- City of Clarence, Glenorchy City Council (1.5)

## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

Anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



### Shrub

Landscaped vegetation as well as bushland shrubs, crops and grapevines.



### Grass

Cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.

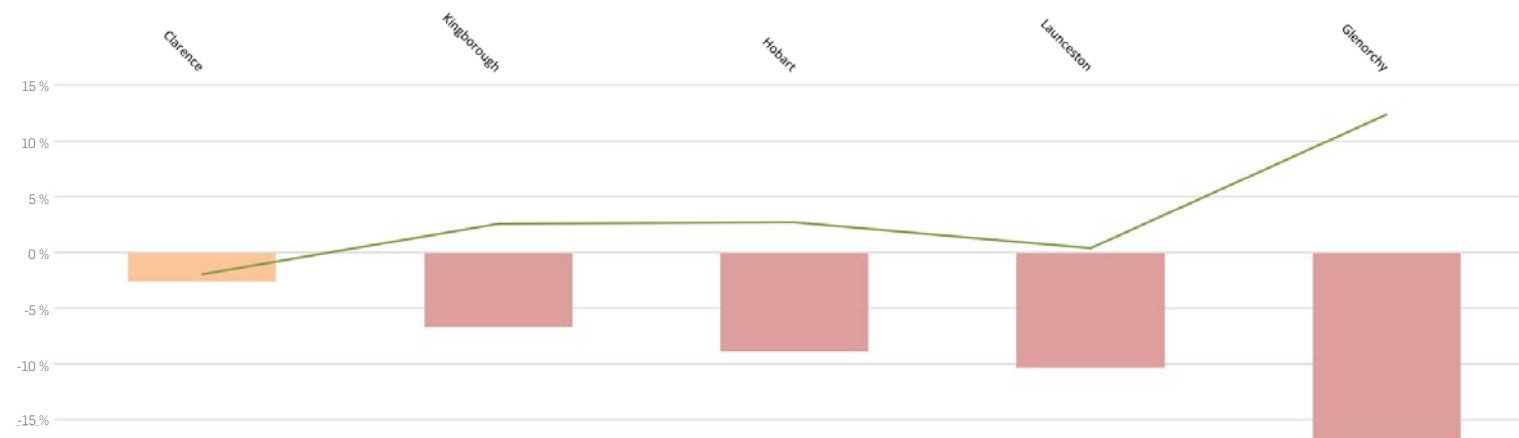


### Hard surfaces

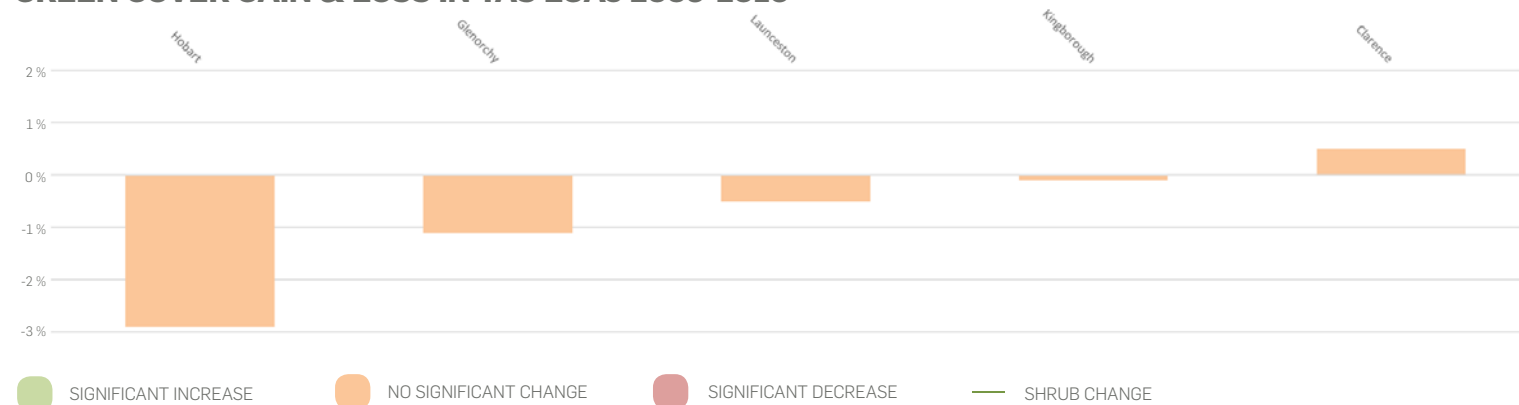
Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	53.8%	44.7%	9.1% Loss
Shrub Cover	8.66%	11.9%	3.24% Gain
Grass Cover	28.4%	33.42%	5.02% Gain
Hard Surface	9.14%	9.96%	0.82% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN TAS LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN TAS LGAs 2009-2016



\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)



# TAS – HOBART (NO DATA COLLECTED\*)

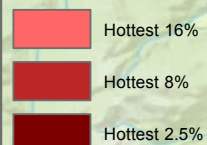
## URBAN HEAT ISLAND MAPPING

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.

\*Hobart was totally obscured by cloud during every overpass of Landsat 8 so no viable data was available.

### Legend

#### Hottest Areas



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, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



THE UNIVERSITY OF  
WESTERN  
AUSTRALIA

# TAS – HOBART (NO DATA COLLECTED\*)

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.

\*Hobart was totally obscured by cloud during every overpass of Landsat 8 so no viable data was available.



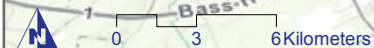
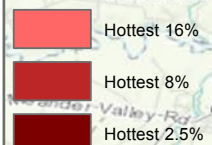
# TAS – LAUNCESTON

## URBAN HEAT ISLAND MAPPING

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas due to human impact of hard surfaces and development. Colours are used below to differentiate intensity of urban heat islands.

### Legend

#### Hottest Areas



Map by: Alex Saunders

Date: 23/05/2017

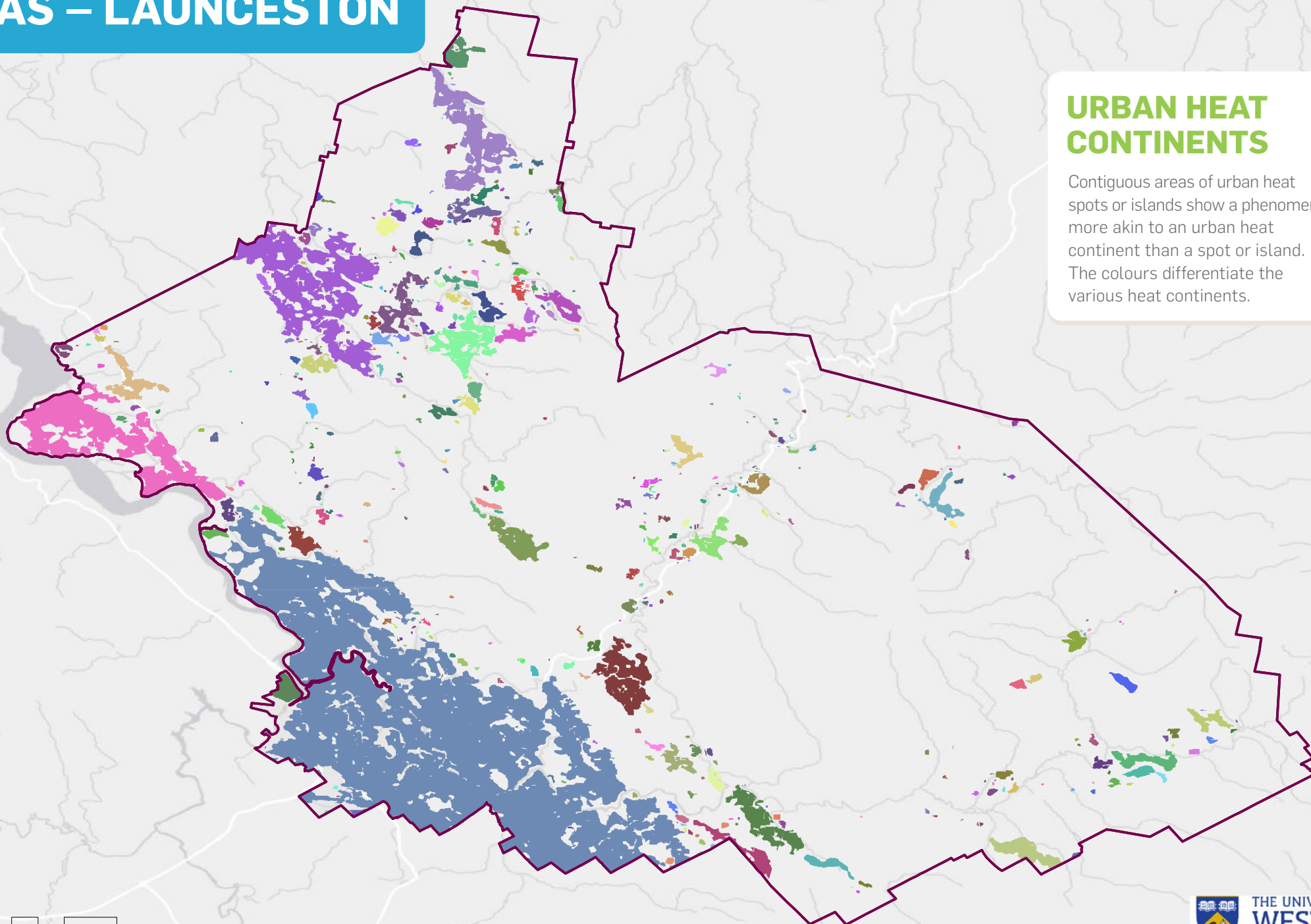
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



# TAS – LAUNCESTON

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.





*The rates of shrubbery cover in Glenorchy City Council will in time compensate for the loss of canopy, assuming that they can grow into healthy, mature trees.*

*Despite having some of the most vulnerable communities, the tree canopy cover on places like Launceston is much higher (44.5%) than other vulnerable communities in the country. It would appear in Tasmania that urban heat is not as much of a major issue – although the risk of bushfire with elevated temperatures may pose a threat.*

*Despite the 8.9% decrease in canopy in Hobart, there has been a 2.7% increase in shrubs and a 3.2% increase in grass, which in time may lead to higher levels of canopy cover.*







# NORTHERN TERRITORY





Average canopy cover  
for urban NT is

**28.9%**

up 0.85% from

**28.05%**

in 2009.



In the City of  
Palmerstone  
there has been a

**5.5%**

increase in tree canopy,  
whereas in the City of  
Darwin, there has been a

**3.8%**

decline in canopy.



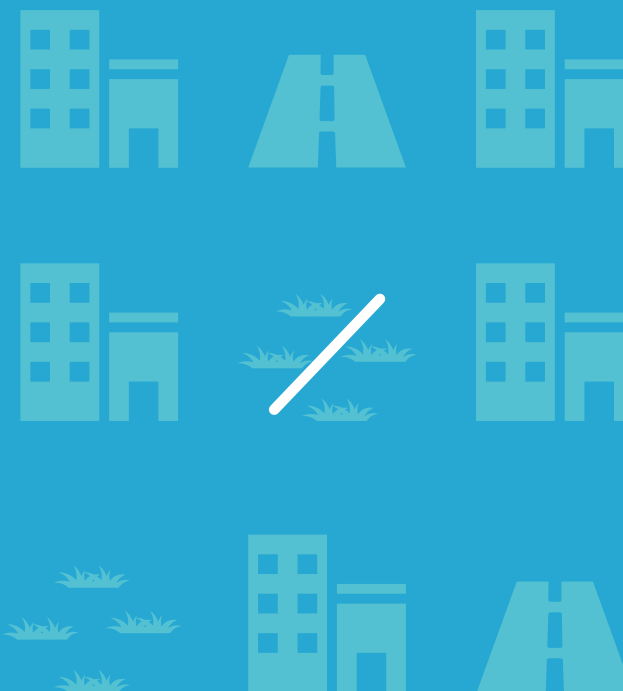
In the City of Darwin,  
there has been a

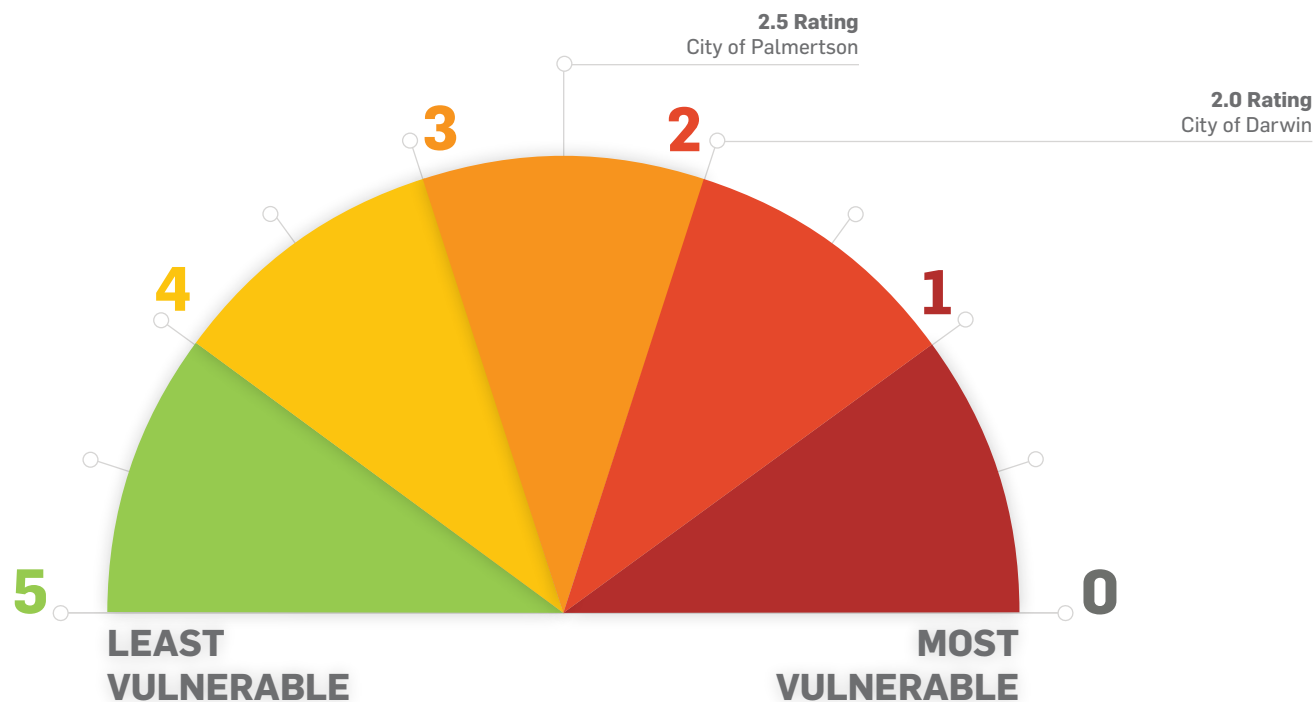
**7.1%**

increase in  
hard surfaces  
and a consequent

**9.1%**

loss in grassed  
areas. This may  
signify an overall  
increase in hard  
surface infrastructure  
at the cost of  
green spaces.





### TOP URBAN GREENING OPPORTUNITIES:

Both the City of Darwin and the City of Palmerston, the only two urban parts of the Northern Territory, would benefit from urban greening.





## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

Anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



### Shrub

Landscaped vegetation as well as bushland shrubs, crops and grapevines.



### Grass

Cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.

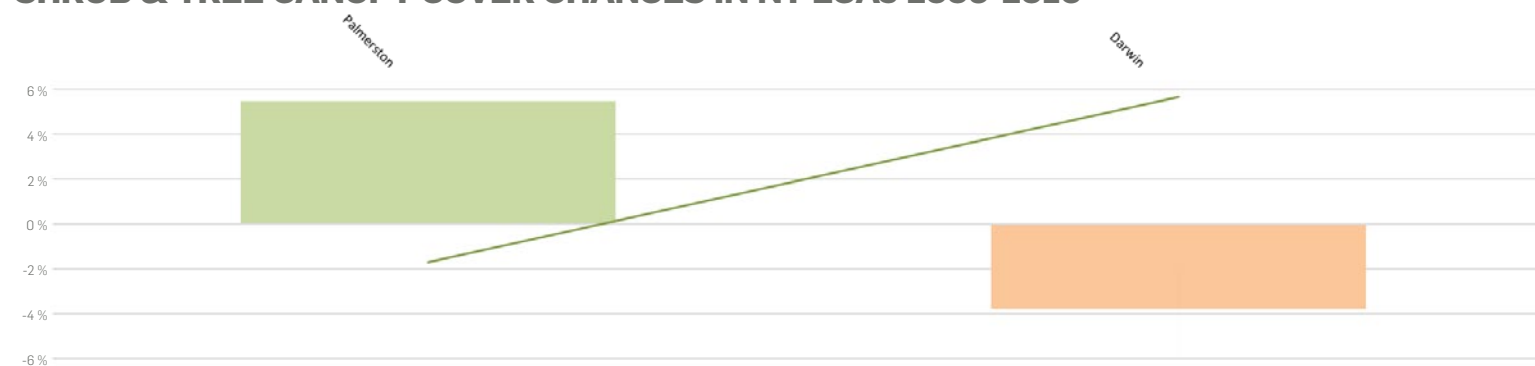


### Hard surfaces

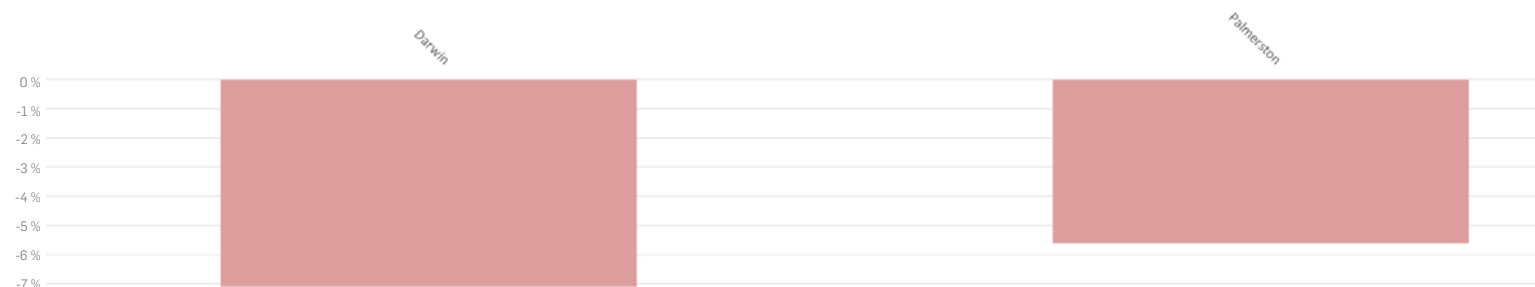
Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	28.05%	28.9%	0.85% Gain
Shrub Cover	8.91%	10.9%	2% Gain
Grass Cover	44.95%	35.7%	9.25% Loss
Hard Surface	18.05%	24.4%	6.35% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN NT LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN NT LGAs 2009-2016



SIGNIFICANT INCREASE



NO SIGNIFICANT CHANGE



SIGNIFICANT DECREASE

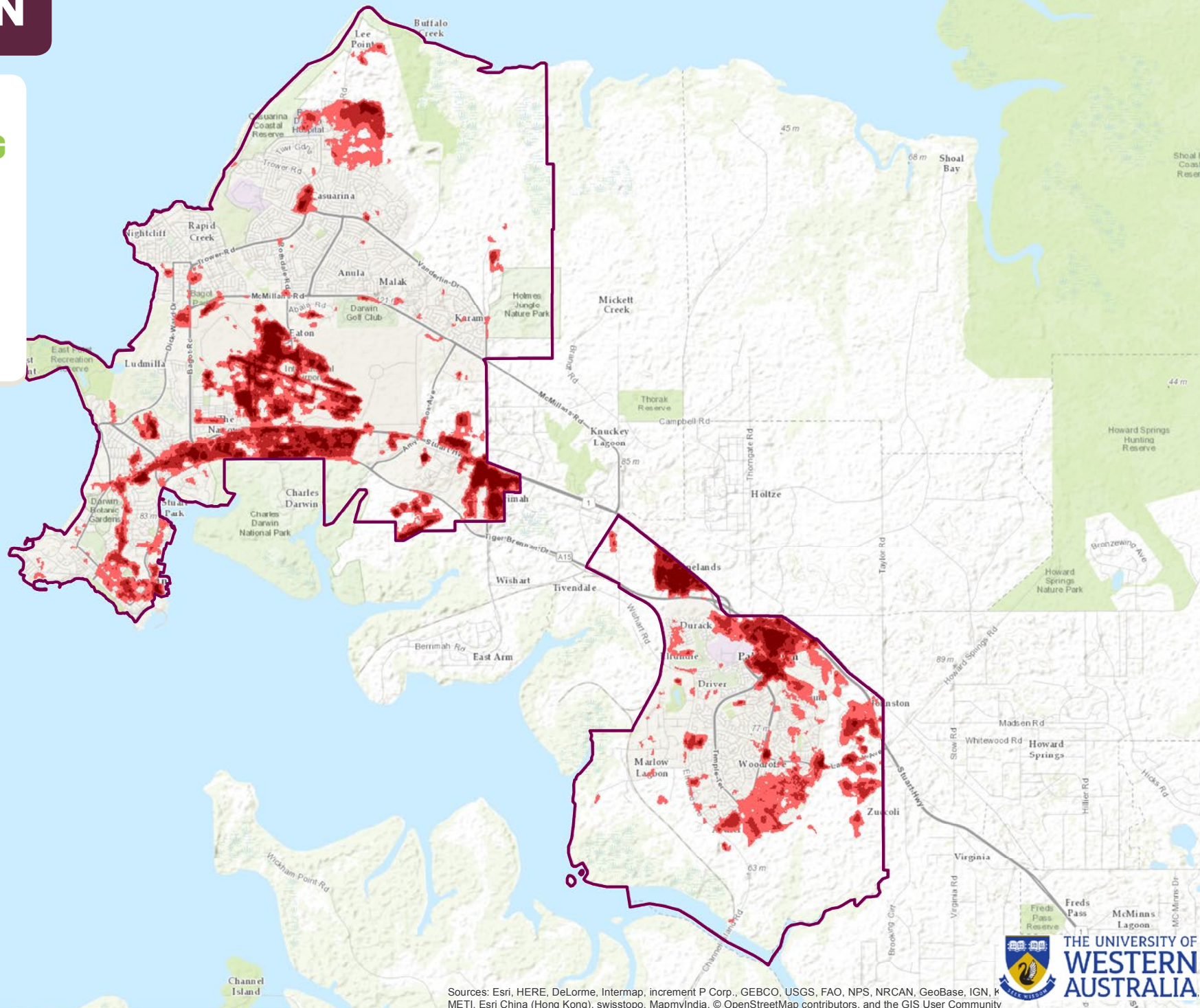
SHRUB CHANGE

\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)

# NT – DARWIN

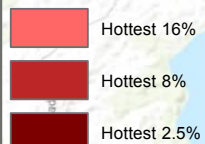
## URBAN HEAT ISLAND MAPPING

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas due to human impact of hard surfaces and development. Colours are used below to differentiate intensity of urban heat islands.



## Legend

### Hottest Areas

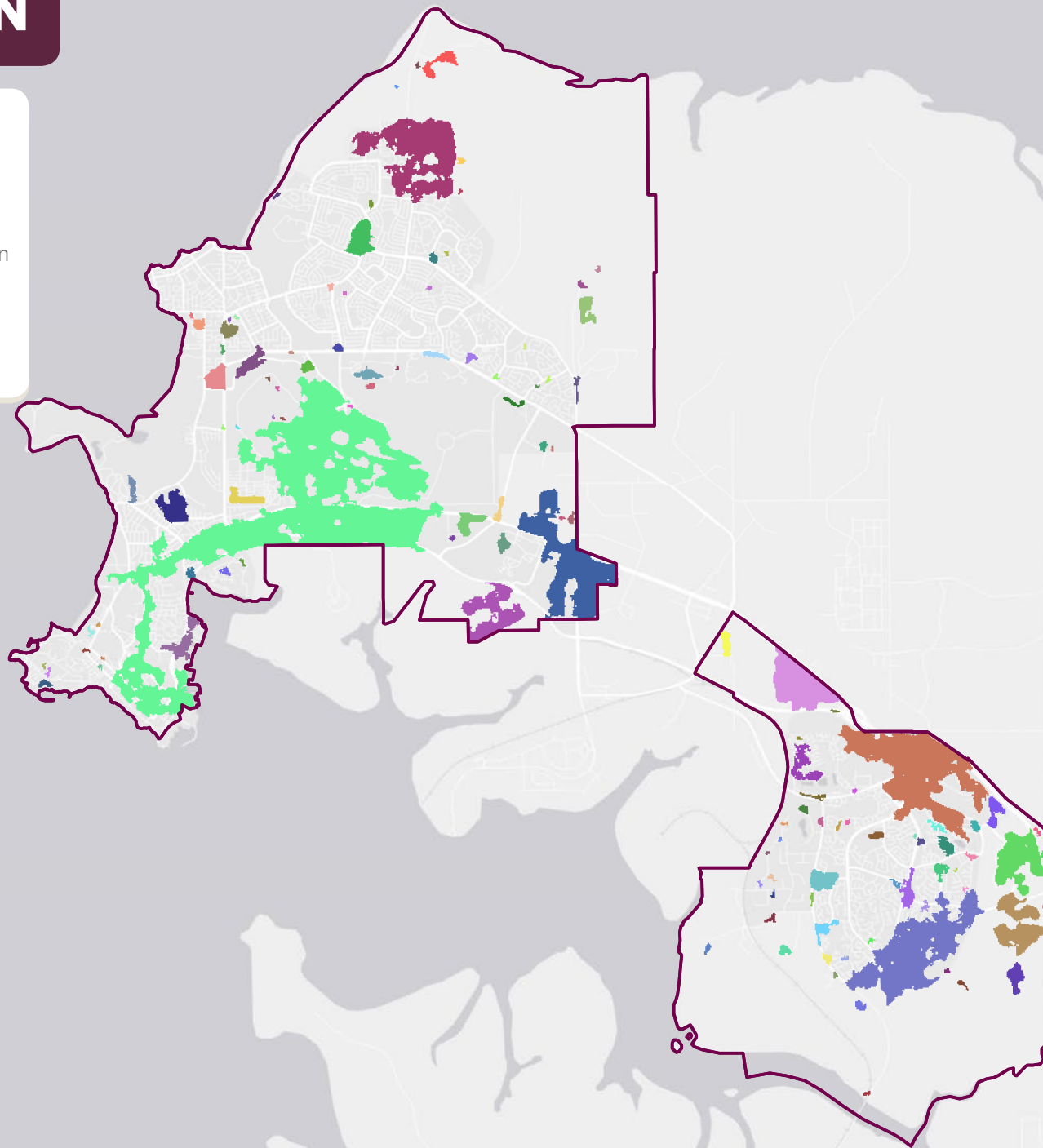




# NT – DARWIN

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.





*Despite the 3.8% decline in canopy in the City of Darwin, there has been a 5.69% increase in shrubbery, which according to trends elsewhere in the country, would suggest an increase in canopy over time.*

*In the City of Palmerston, the 5.6% increase in hard spaces has been balanced out by an almost equivalent increase in canopy cover.*





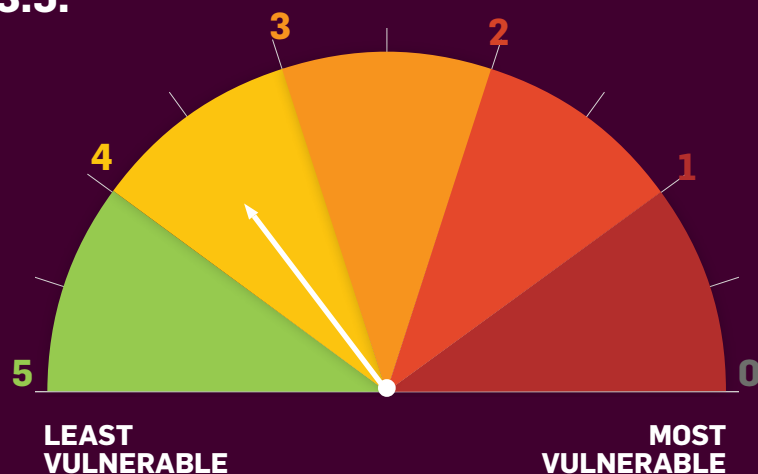
# THE AUSTRALIAN CAPITAL TERRITORY





Given that the ACT does not have delineated local government areas, the vulnerability indexation has occurred as an overall measure of the territory and

**IS RATED AT THE LEAST VULNERABLE END OF THE SCALE AT 3.5.**



The ACT has very high canopy coverage overall, however like in other places with high levels of canopy cover it is declining at a very high rate. In the ACT there has

**BEEN A 10.7% CANOPY LOSS SINCE 2009.**







## THE GREEN KEY

In technical terms, a tree is a plant over six metres, while a shrub is under six metres. However, for an accurate comparison to our previous mapping report, 'Where are all the trees?', we have used the following definitions:



### Trees

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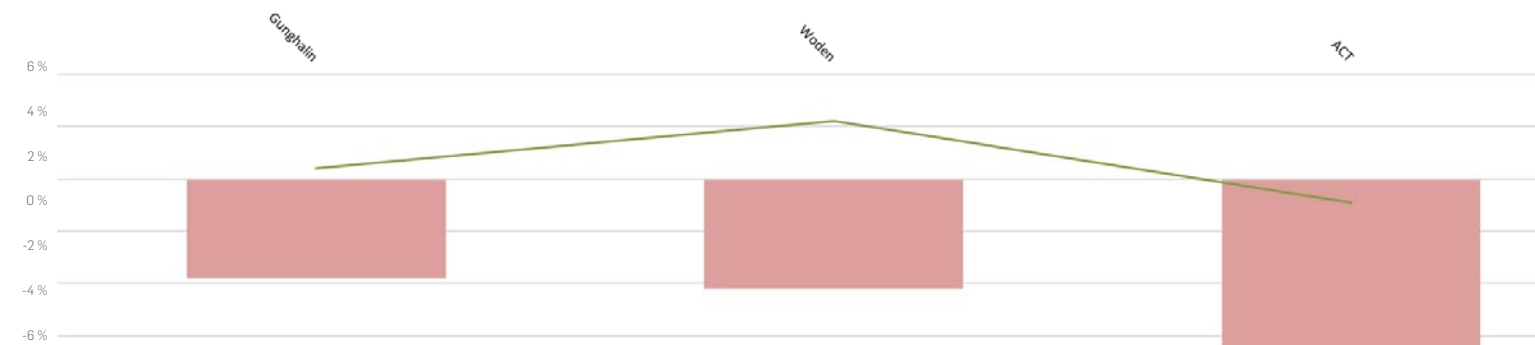


### Hard surfaces

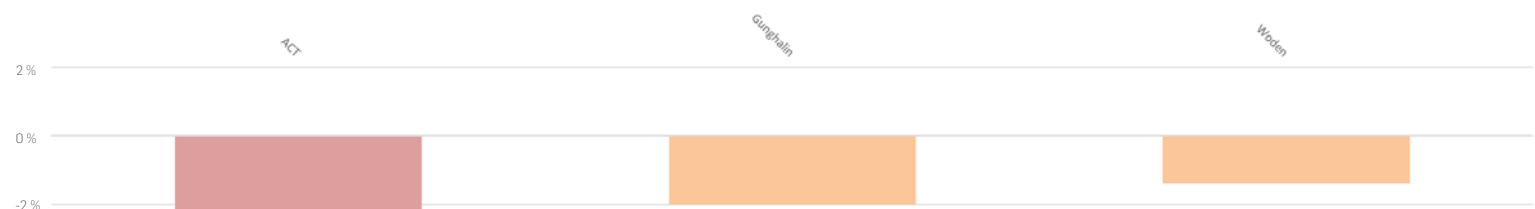
Asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

KEY STATISTICS	2009*	2016	
Tree Canopy Cover	56.3%	45.6%	10.7% Loss
Shrub Cover	5.4%	4.5%	0.9% Loss
Grass Cover	33.1%	42.5%	9.4% Gain
Hard Surface	5.2%	7.4%	2.2% Increase

## SHRUB & TREE CANOPY COVER CHANGES IN ACT LGAs 2009-2016



## GREEN COVER GAIN & LOSS IN ACT LGAs 2009-2016



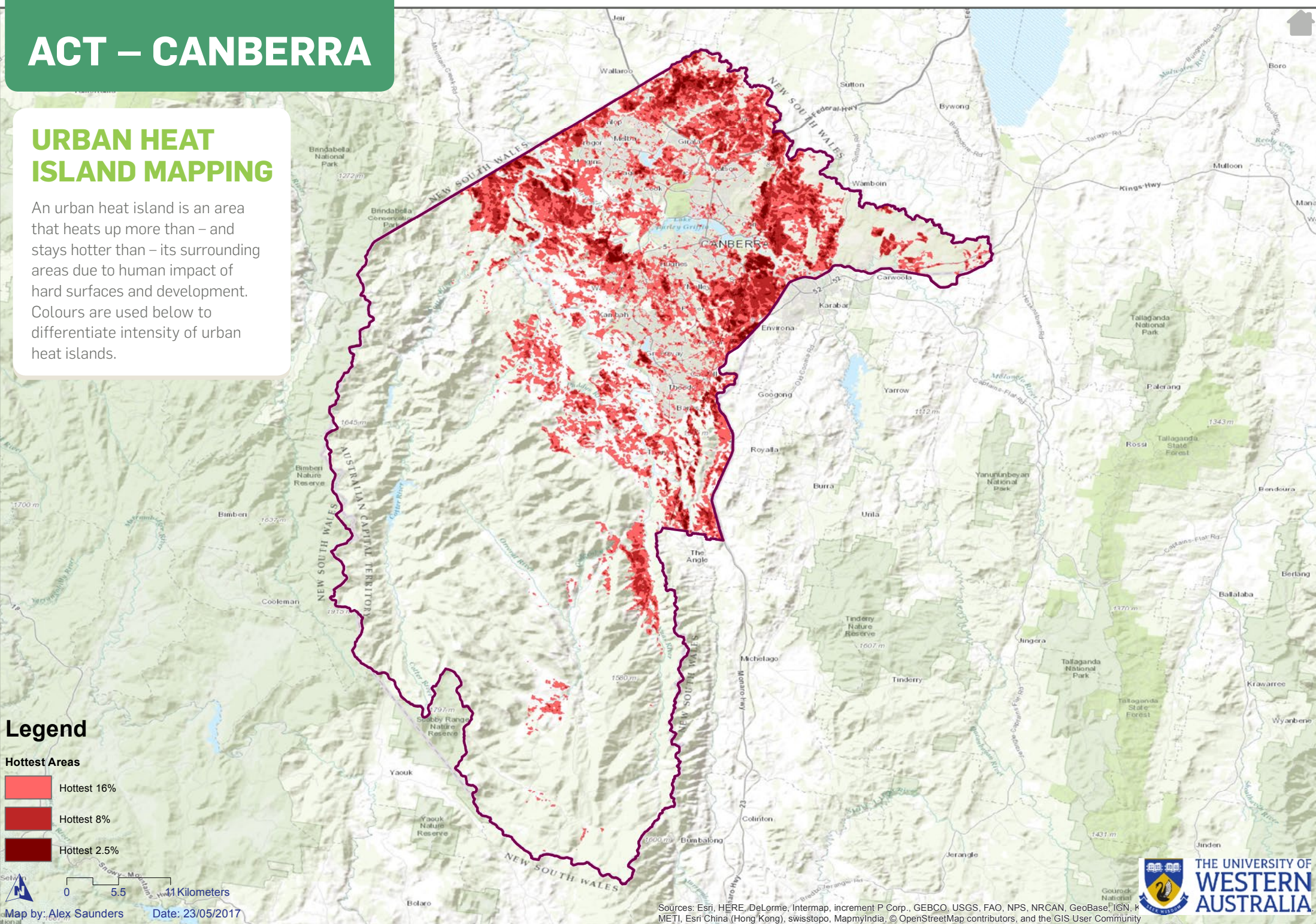
\* From 'Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment', Final Report (2014)



# ACT – CANBERRA

## URBAN HEAT ISLAND MAPPING

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas due to human impact of hard surfaces and development. Colours are used below to differentiate intensity of urban heat islands.

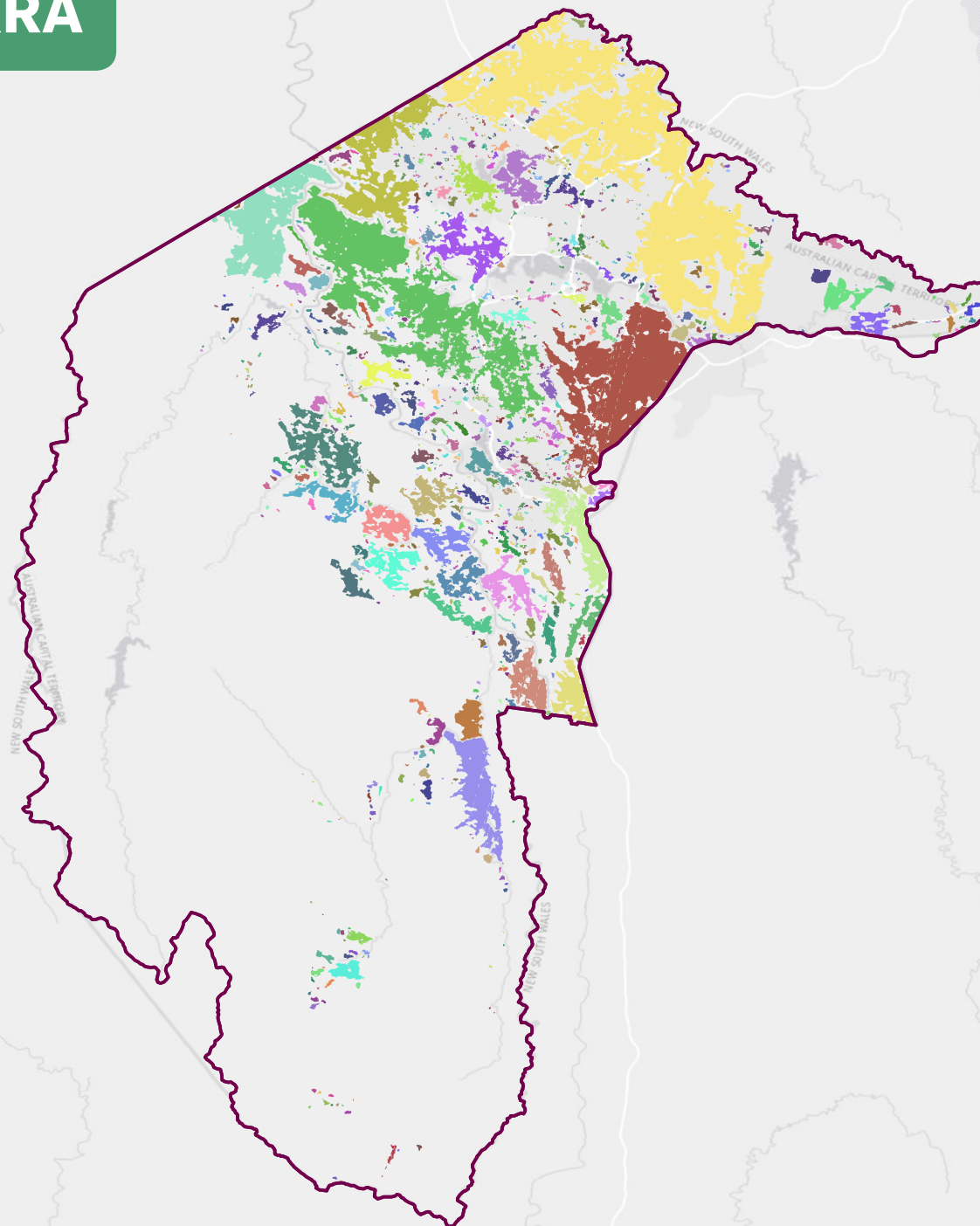




# ACT – CANBERRA

## URBAN HEAT CONTINENTS

Contiguous areas of urban heat spots or islands show a phenomenon more akin to an urban heat continent than a spot or island. The colours differentiate the various heat continents.





*Hard surfaces have only increased by 2.2% overall, whereas grassed areas have increased by 9.4%. It is unclear as to whether the increase of grassed surfaces has come at the cost of canopy. However it would appear so given the close correlation of numbers – 9.4% increase in grass and 10.7% loss in canopy.*







# NEED MORE DETAIL?

AN INDIVIDUAL SNAPSHOT IS AVAILABLE FOR YOUR LGA ON REQUEST.



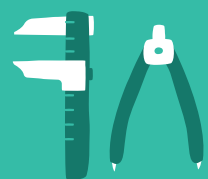
Contact [hello@202020vision.com.au](mailto:hello@202020vision.com.au) to request yours.



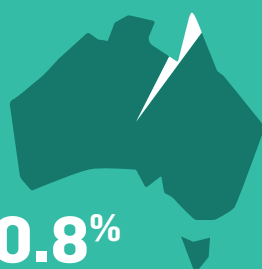


# METHODOLOGY

## AT A GLANCE



=



**155,436 km<sup>2</sup>**

*of urban area has been measured.*

**0.8%**

*of Australia's land mass.*



*More than of population live within  
the LGAs assessed.*



*researchers  
on the team.*



*LGA's  
per state*

**19**  
SA

**01**  
ACT

**02**  
NT

**34**  
VIC

**05**  
TAS

**29**  
WA

**10**  
QLD

**39**  
NSW

*random points  
samples taken in  
each LGA.*







# THE VULNERABILITY INDEX

Where should all the trees go? In simple terms, where they can create the greatest health, cooling and liveability benefit to urban communities.

To determine where trees and plants will have the most benefit, the researchers at RMIT developed the VHHEDA Vulnerability Index.

The Index brings together three factors to paint a holistic, numerical rating of an area's vulnerability:

## 1. CHANGES IN TREE CANOPY

over time using i-Tree canopy analysis.

## 2. URBAN HEAT

to identify hotspots and patches.

## 3. SOCIO-DEMOGRAPHIC INDICATORS

including self-assessed health, diabetes, the age of the population and economic situation.

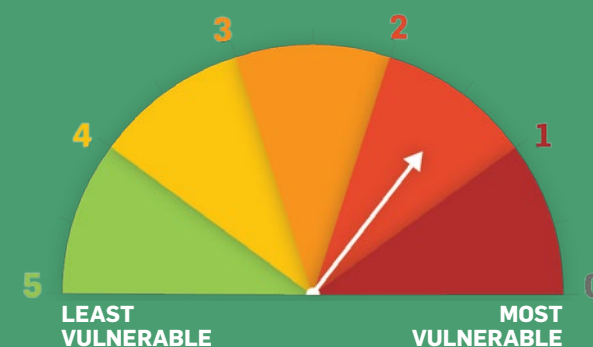


Once the Index was established for each LGA, The 2020 Vision team surveyed a representative from each Local Government to provide available additional information and data to better understand the results.

The combination of mapping and local council insight then enabled us to understand where the biggest economic, social, health, cooling and ecological gains might be made through the investment in more and better urban green spaces.

## THE VHHEDA INDEX:

**V**ulnerability to **H**eat, poor **H**ealth, **E**conomic **D**isadvantage and **A**ccess to green spaces.



The Index provides a simple benchmark to identify trends, areas of concern and where gains might best be made.

It is intended to help inform local, metropolitan and state decisions and investment in urban green space.

## WANT ALL THE RESEARCH DETAILS?

Access the full report online at  
[2020vision.com.au/research](https://2020vision.com.au/research)



# MEASURING CHANGES IN TREE CANOPY:

Given that data to create an urban canopy benchmark happened in 2013 (*'Where are all the Trees?'*) the research team used the same methodology to understand how things had changed over time – this ensured an 'apples with apples' comparison.

When it comes to measuring tree canopy cover and other land uses there are a range of tools that can be used. The reason our researchers chose i-Tree was because they believed it to be robust, cost effective and its limitations are well understood.<sup>3 4</sup>

## THE PROCESS:



1 Researchers used Nearmap aerial images for each LGA because they offer much better clarity than Google Maps.



2 Images used were taken during summer to ensure that maximum leaf coverage was captured.



3 1,000 random points were generated and scattered throughout the LGA boundary.



4 Analysts within the team were trained to use i-Tree to interpret and obtain reliable data from the maps.



5 The analysts' job was to identify each of the 1,000 random point samples within each LGA as either a tree, shrub, bare ground/ grass or hard surface – the same categories that were used in the 2013 report.



6 Then, big deviations were checked again by different analysts. The standard errors were calculated and used to identify which changes were significant to 95% certainty.

## WHAT TYPES OF SURFACES WERE WE LOOKING FOR?



**Tree** – anything that looks like a tree from above, distinguished from shrubs by the shadows cast.



**Shrub** – landscaped vegetation as well as bushland shrubs, crops and grapevines.



**Grass** – cleared road sides, lawns, pastures, sites cleared for development and sporting grounds.



**Hard surface** – asphalt, buildings, car parks, footpaths, sandy beaches, train lines, rocky coastlines and water.

3. 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. Kaspar, J Kendal, D Sore, R and Livesley, SJ (2017) Random point sampling to detect gain and loss in tree canopy cover in response to urban densification, Urban Forest Urban Greening, 24, 26-34.



# MEASURING URBAN HEAT

Generating heat maps for specific regions requires stitching a range of individual datasets and equations together. The most important thing is to be able to measure the difference in temperature between an urbanised and a non-urbanised area.

To measure urban heat, researchers calculated a temperature gradient that took into account not only the heat differences in urbanised areas, but also the contribution of forest boundaries, high slopes, elevation and distances from the coast as factors that contribute to urban heat.

Researchers also took into account that in different places the temperature range varies considerably, for example, in the tropics, temperature might only oscillate between 28 – 35 degrees, whereas down south, temperatures can range from between 0 – 40 degrees.

## THE PROCESS

If you are really keen to get into the nitty gritty of the methodology, you should go and check out page 7 of the [RMIT report](#)<sup>5</sup>, but if you're just after the 'gist', the main things you need to know are that:



Our study window was October 2015 – April 2016, during this time a satellite called Landsat 8 passed over each location taking high resolution thermal images every 16 days.



These images were processed in a way that took into account thermal infrared data, atmospheric water vapour and reflections, and came up with an average temperature range.



The images and the layers of data were stitched together to provide a composite map of temperature with those temperatures that deviate considerably from the vegetated areas identified as heat spots.

5. Amati, M. Boruff, B. Caccetta, P. Devereux, D. Kaspar, J. Phelan K. and Saunders, A. (2017) 'Where should all the trees go?' Investigating the impact of tree canopy cover on socio-economic status and wellbeing in LGA's prepared for Hort Innovation by the Centre for Urban Research, RMIT University





# THE URBAN HEAT CONTINENT:

The conventional academic wisdom defines a Heat Island as the difference in temperature of an urbanised area compared to a geographically-equivalent non-urbanised baseline.

As most of us trying to sleep on a hot summer night will agree, the Heat Island effect is most pronounced once the sun goes down. Urban areas take longer to cool down compared to surrounding rural areas. This is because the built form (buildings, roads, bridges etc.) in cities and urban areas store more heat than green spaces. Urban areas also produce heat through air conditioning and wind speed is slower, which again means that cooling takes longer. In contrast, tree canopies produce shade which reduces the amount of solar radiation that hard surfaces receive and absorb.

The heat mapping indicated that there are large temperature fluctuations within Australian cities where a hotspot can be understood as approximately 10 degrees Celsius warmer than the norm. These hotspots can cover large areas of the city, and are found to be associated with areas of socio-economic disadvantage.

While many people are familiar with the concept of urban heat 'spots' or 'islands' to describe urban heat throughout summer, the largely uninterrupted and contiguous heat patches shown by this research, shows that large areas of metropolitan areas are covered by a single hotspot that is more akin to a heat continent than a heat island.

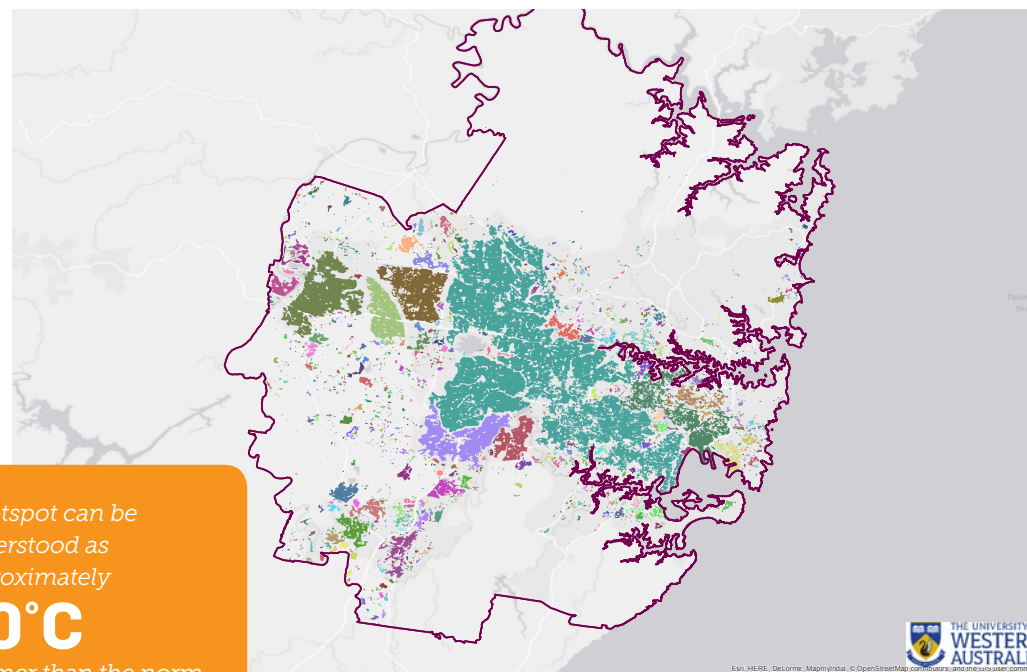
In contrast, cooler parts of Melbourne and Sydney tend to be located within proximity to national parks and socio-economic affluence as measured by the SEIFA Index. Melbourne's eastern areas are generally cooler than those in the West. In Sydney, the upper North Shore is cooler compared to areas to the South and West. Even in highly urbanised contexts, river corridors and large areas of green space such as golf courses have clear cooling effects on heat patterns. This highlights the importance of corridors of native bush, in both urban and rural areas.

6. Amati, M. Boruff, B. Caccetta, P. Devereux, D. Kaspar, J. Phelan K. and Saunders, A. (2017) 'Where should all the trees go?' Investigating the impact of tree canopy cover on socio-economic status and wellbeing in LGA's prepared for Hort Innovation by the Centre for Urban Research, RMIT University.

*"A key task for strategic planning of green infrastructure in large metropolitan areas will be to invest resources in planting corridors and attempting to break up patches of high heat anomalies. These large patches form a stable area of heat in a city and may resist mitigating effects of wind when compared to smaller patches. Some areas of extreme heat anomalies exist in areas of relative socio-economic disadvantage, for example in Sydney's West."*<sup>6</sup>

- Dr Peter Caccetta, CSIRO Data 61

This map shows that in Australian cities a single patch of heat island (or 'continent') can occupy large areas of the city.



A hotspot can be understood as approximately  
**10°C**  
warmer than the norm.

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





# MEASURING THE RISK & VULNERABILITY BASED ON PEOPLES' HEALTH, AGE & ECONOMIC SITUATION

One of the major barriers encountered by researchers was the availability of social and economic datasets.

While all of the canopy and heat measurements were made in 2016, the socio-economic data it is compared to comes from the 2011 Census – the only census information available at the time of the research.

One of the other things researchers were very careful to consider was the extent to which they could draw statistical conclusions. This was due to the availability of socio-economic and health data that was quite detailed – down to a street level, and canopy mapping data being taken at the broader LGA level.

To overcome these limitations the research team developed the VHHEDA Index. The purpose of the Index was to rank LGAs across Australia in a way that could be used by decision-makers to reach conclusions about the vulnerability of their residents. The Index is a relative estimate of risk as opposed to an absolute measurement.

## THE PROCESS BEHIND THE VHHEDA INDEX:

A range of datasets were combined and overlaid so that researchers were able to gain a sense of which LGAs were most vulnerable. For example, a specific LGA may have lost a great deal of canopy and have heat spots, but if the population was wealthy enough to be able to move to another area, they would be rated as less vulnerable. In contrast, a LGA that was really hot, had undergone relatively little canopy loss (but the overall percentage was low) but whose population had limited economic choices, would be rated as much more vulnerable.

To that end, the VHHEDA Index was based on the following:



Population of under 5s and over 65s who live alone.



The percentage of canopy the LGA had versus the percentage of hotspots.



Peoples' self-assessed health compared to actual incidences of diabetes (Health ASR 100).



Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-Economic Disadvantage versus SEIFA Index of Economic Resources – how much money people had which included assets they had.



The rate at which canopy had increased/decreased as a percentage versus the overall percentage of canopy cover (so, how many trees you had lost/gain as a proportion of how many you had to begin with, so if an LGA began with lots of trees and lost a fair amount, that would be indexed differently to an LGA that had few to begin with and lost a similar amount).



All of these factors were combined and then divided into a five-point scale.



## RESEARCH LIMITATIONS

- The research methodology was based on i-Tree which is a sample-based study. A sample approach is relatively cheap and useful for a benchmarking exercise. It doesn't tell you where all the trees are at a scale less than the LGA.
- Many of the metropolitan LGAs that were studied contain national parks. Trees and shrubs are subject to dieback and leave new opportunities for new vegetation to grow.
- There is a natural exchange between tree canopy cover and shrubs. In LGAs where there has been a significant loss in tree canopy over a five-year period (2009- 2016) these losses are offset by gains in shrub cover (which would also include saplings) during the same period.
- Bushfire or drought can reduce tree canopy but allow shrubs or juvenile trees to take their place.
- Our team members are only human, so there is an unavoidable chance that some misclassification of a tree as a shrub may have occurred.





# BENCHMARKING FOR URBAN GREENING

The project reaffirms that i-Tree is a useful methodology for measuring and monitoring urban green space, but it isn't without its limitations – namely, the ability to understand what is happening with green space at the street level.

For future consideration, researchers suggest:

- If you're going to use tree canopy levels as a benchmark for urban greening, you also need to consider shrubbery.
- Benchmarking has to happen at the sub-LGA level so that we can go beyond understanding canopy cover as a percentage of an LGA and instead consider what's happening at a street level – you would have more detailed and accurate comparisons if heat and socio-economic data was taken at this more detailed level.
- It is possible to benchmark not only canopy but also urban heat island for Australian cities.

## UNDERSTANDING URBAN HEAT

The study shows that it is possible to capture Landsat 8 images and understand urban heat. Researchers say that it would be quite possible and relatively cost-effective to collect this data at regular intervals as opposed to LGAs having to pay significant amounts of money for aerial heat photography.

The resolution of the photography also means that it is possible to identify the location of heat sources and potentially identify possible greening locations such as large areas of railway land, roads and alongside major highways.







# WHAT IS THE 202020 VISION?

The 202020 Vision is a mass collaboration of organisations working together to create 20% more and better green space in urban areas in Australia by 2020.

Since 2013, it has grown into a network of more than 400 member organisations and individuals and collaborated on a range of projects that provide the tools, resources and networks necessary to achieve this common vision.

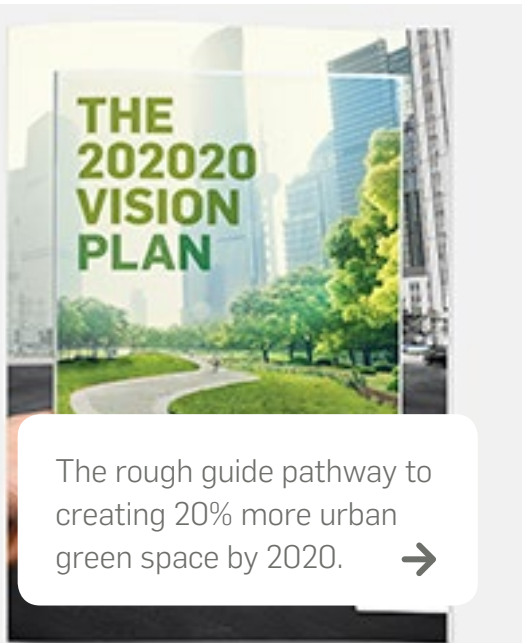
The 202020 Vision is commissioned by Hort Innovation for the Australian nursery industry using levy contributions.



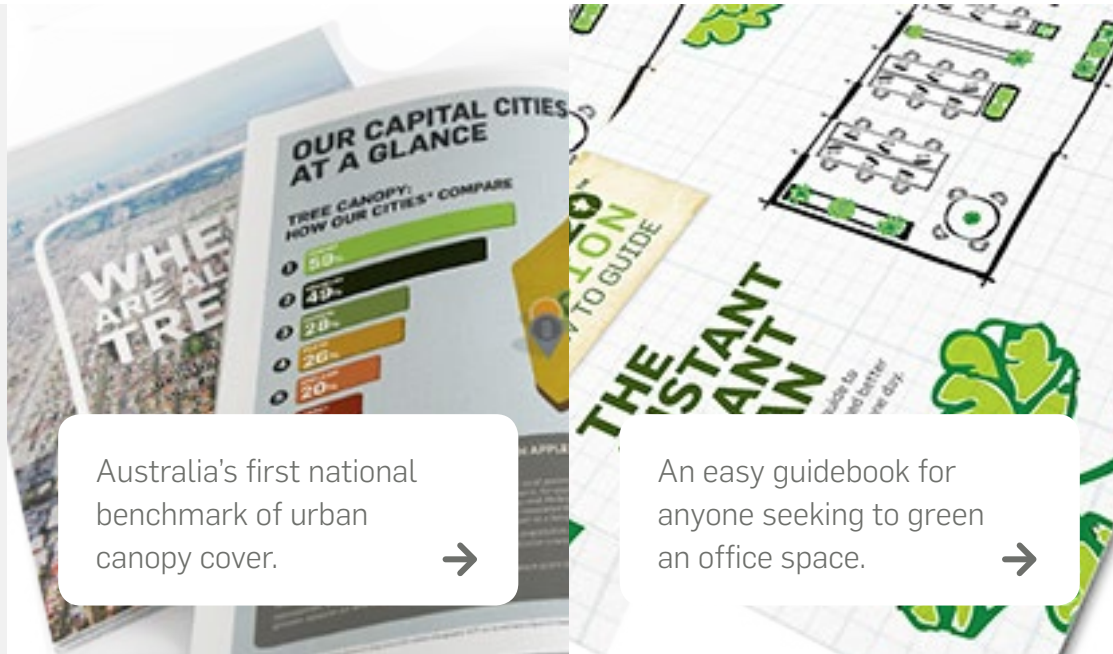


# ALSO FROM THE 202020 VISION

All available at [202020vision.com.au](http://202020vision.com.au)



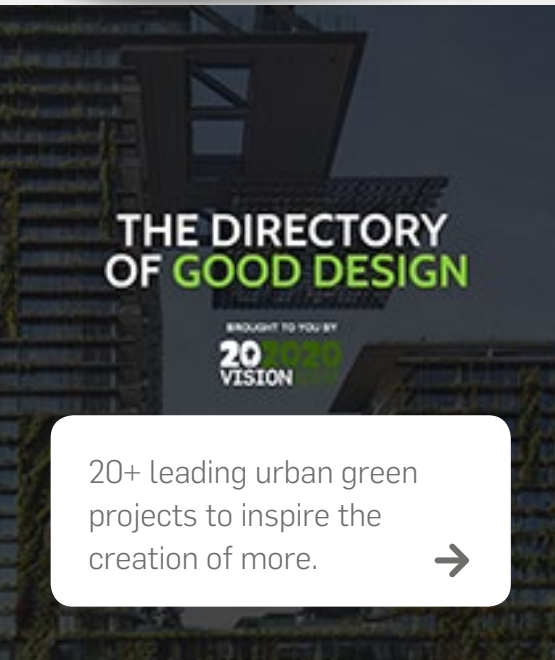
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20% MORE GREEN SPACES  
IN URBAN AREAS BY 2020