WSROC

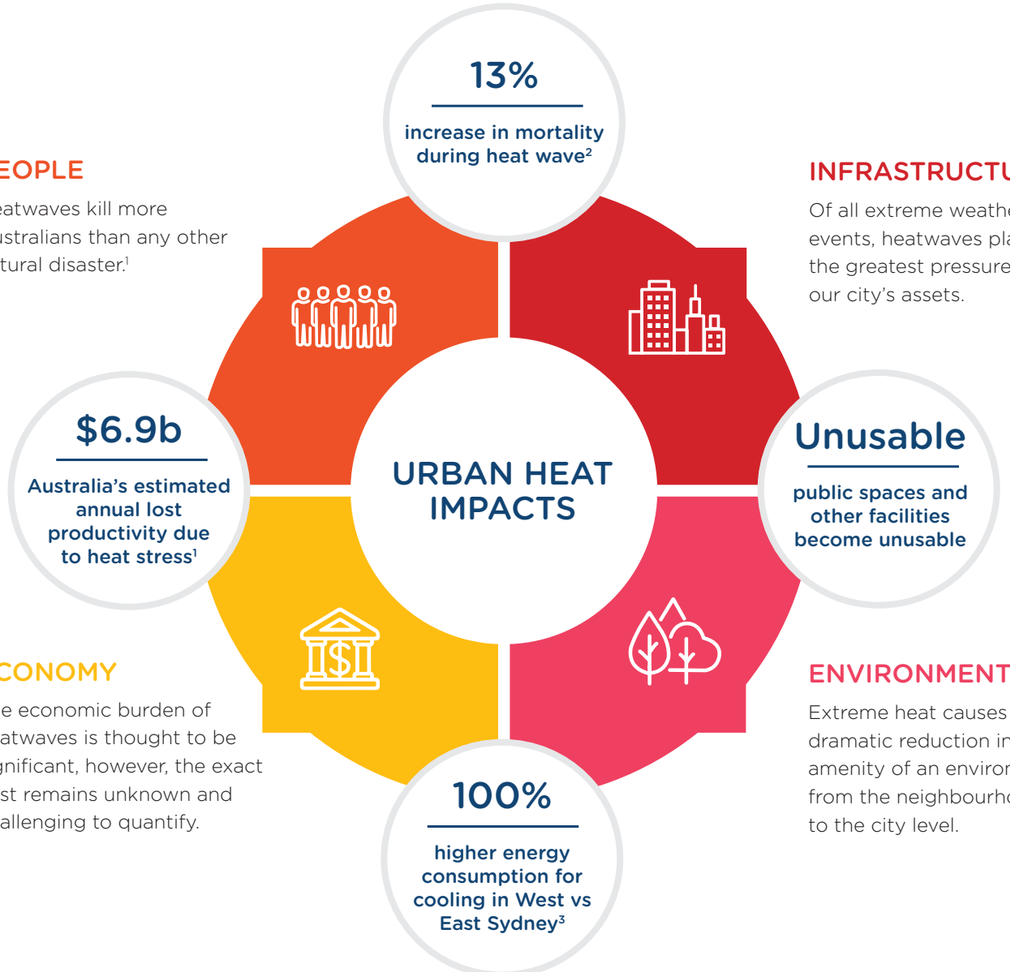
TURN DOWN THE HEAT

TURN DOWN THE HEAT

STRATEGY AND ACTION PLAN

2018

URBAN HEAT IMPACTS ALL ASPECTS OF OUR CITIES



WSROC acknowledges Aboriginal and Torres Strait Islander peoples as the traditional custodians of the lands and waters of this place we now call Metropolitan Sydney. We pay our respect to Elders past, present and future of the Eora, Dharawal (Tharawal), Gundungurra, Dharug (Darug) and Guringai (Kuring-gai) peoples.

This strategy, developed by AECOM, has been published by WSROC with assistance and support from a range of organisations and individuals.

A full list of stakeholders engaged through the strategy development process is included at the end of this document.

If you are looking for more information about this strategy or would like to get involved in this effort, please reach out to **info@wsroc.com.au**.

Image credits: WSROC unless otherwise noted, with thanks to member councils for providing images.

TURN DOWN THE HEAT STRATEGY AND ACTION PLAN

This strategy has been prepared to increase awareness and facilitate a broader and more coordinated response to the challenges of urban heat in Western Sydney.

A LETTER FROM OUR STEERING COMMITTEE

It is with much pleasure that we present the Western Sydney Turn Down the Heat Strategy and Action Plan.

Turn Down the Heat is a remarkable collaboration between a regional, cross-disciplinary group of stakeholders who collectively recognise the importance of implementing solutions for a greener, cooler, more liveable and resilient Western Sydney. We specifically recognise that in the Western Sydney context, addressing urban heat is a matter of survival for vulnerable communities.

This strategy has been prepared to increase awareness and facilitate a broader and more coordinated response to the challenges of urban heat in Western Sydney. We recognise the considerable efforts of the many stakeholders who play a role in addressing the growing problem of urban heat in Greater Sydney. This initiative aims to build on those efforts and looks to advance the recognition that urban heat is a priority issue in Western Sydney, which will continue to increase under the dual pressures of urbanisation and climate change.

The strategy reflects insight and inputs from stakeholders including local councils, state government, businesses, researchers, developers, infrastructure and critical service providers, as well as health and community service providers who have participated in a series of workshops, forums and interviews in 2017.

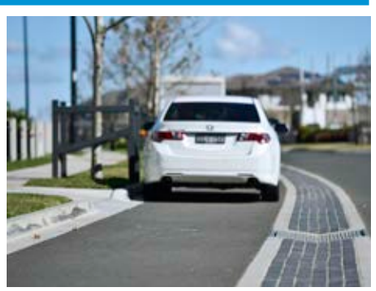
We hope that after reading this strategy, you see a role for yourself as a champion within the organisation you represent to further develop and implement actions to reduce the impact of urban heat across Western Sydney.

We ask that you:

- Advocate for urban heat to be recognised as a priority issue for Western Sydney
- Share your successes and lessons learnt on addressing urban heat with others across Metropolitan Sydney
- Join us by participating in our working groups to develop and implement the priority actions

Signed by,

Western Sydney Regional Organisation of Councils, Western Sydney University, Western Sydney Local Health District, Resilient Sydney, NSW Office of Environment and Heritage, Government Architect NSW, Greater Sydney Commission, and City of Parramatta Council



Urban heat in Western Sydney

CONTENTS

SECTION 1.0

DEVELOPING THE TURN DOWN THE HEAT STRATEGY AND ACTION PLAN

1.1 COLLABORATING FOR A COOLER, MORE LIVEABLE AND RESILIENT WESTERN SYDNEY

The Turn Down the Heat Strategy has been prepared in collaboration with stakeholders from a diverse range of sectors including health, infrastructure, academia, planning, utilities and non-profit. Combining the expert knowledge, skills and resources of these stakeholders is essential to comprehensively address urban heat. As a collective we will need to continue to build collaboration between sector experts to ensure the goals of the strategy are achieved.

Creating cool and walkable places

TURN DOWN THE HEAT

Universally, extreme heat has been prioritised as a key issue of concern for governments, organisations, businesses and communities alike. What is now urgently needed is coordination and action. The Turn Down the Heat initiative offers a pragmatic response to the challenges of urban heat where it is felt most; Western Sydney.

Turn Down the Heat seeks to:

- Represent the interests of the residents of Western Sydney;
- Enhance existing efforts to address urban heat;
- Collaborate across the region to increase awareness; and
- Facilitate a broader and more coordinated response to the challenges of urban heat.

This strategy presents a five-year plan for addressing urban heat across the region. The strategy builds on inputs provided by 55 different organisations through workshop forums and interviews throughout 2017.

The overarching aim of the Turn Down the Heat program is to reduce the debilitating effects of urban heat on people. The strategy seeks to:

1. Identify and leverage existing best practice to develop a program of effective actions at household, precinct and regional levels;
2. Acknowledge the limitations of the current policy framework with regard to urban heat to galvanise action across diverse stakeholders;
3. Propose a series of priority actions for development with a broader stakeholder group.

WHY IS THIS STRATEGY NEEDED

This strategy is needed to facilitate a broader and more coordinated response to the challenges of urban heat in the absence of coherent state or national policy.

How we respond to the challenge of urban heat spans the roles and responsibilities of many different organisations and public sector agencies. There is a very real deficit of understanding the economic, environmental and social impacts of urban heat across Greater Sydney. While local government and health providers are often closest to the community impact of urban heat on residents, they are not always empowered from a regulatory or resource perspective to develop and drive adaptation outcomes.

Thankfully, urban heat is gaining recognition across planning policy, with Resilient Sydney identifying extreme weather events, including heatwaves as Metropolitan Sydney's greatest shock event. The Greater Sydney Commission has identified heat as a key stressor for Greater Sydney, and the Office of Emergency Management has identified heatwaves as an extreme risk for NSW (The figure on page 10 shows the current policy landscape addressing urban heat).

While urban heat is recognised by many organisations serving the Greater Western Sydney region, implementation of action is fragmented, often due to differences in administrative boundaries or misalignment of priorities.

Strategic planning documents such as the Greater Sydney Commission District Plans look to integrate urban heat considerations into strategic planning, but divide the Greater Western Sydney region between the Western City and Central City Districts.

NSW Health's successful Beat the Heat program is working to reduce community health impacts but is managed via three Local Health District Boards; Nepean Blue Mountains, Western Sydney, and South Western Sydney. Local councils also run targeted programs in their own Local Government Areas.

In this space, the Turn Down the Heat Strategy aims to complement existing policies and strategies to create local, practical and coordinated action in the short, medium and long term. It aims to build on existing efforts and looks to advance the recognition that urban heat is a priority regional issue in Western Sydney.

Engaging across the Greater Western Sydney region

Forums

180 participants from 55 organisations including: community organisations, developers, industry, research, health providers, local and state government, strategic planning bodies, and infrastructure providers

Interviews

20 participants from 15 organisations spanning research, health providers, local and state government, strategic planning bodies, and infrastructure providers

Steering Committee

City of Parramatta Council, Greater Sydney Commission, NSW Government Architects Office, NSW Office of Environment and Heritage, Resilient Sydney, Western Sydney Local Health District, Western Sydney Regional Organisation of Councils, and Western Sydney University

MARCH 2017

- Turn Down the Heat Forum One hosted by WSROC and Western Sydney University

JULY 2017

- Steering Committee formed

OCTOBER 2017

- Desktop study initiated
- Stakeholder interviews conducted

NOVEMBER 2017

- Turn Down the Heat Forum Two (Action Planning) hosted by WSROC and Western Sydney University

DECEMBER 2017

- Finalising strategy and action plan

2018

- Launch and implementation

Turn Down the Heat strategy development process

Policy landscape addressing urban heat

DEVELOPMENT FRAMEWORKS

Greater Sydney Commission - A metropolis of three cities, The Greater Sydney Region Plan (2018). District plans for Western and Central City districts (2018).

NSW Department of Planning and Environment – State Environmental Planning Policies

Local Government - Local Environment Plans and Development Control Plans

Sydney Water - Western Sydney Regional Master Plan (2018)

RESILIENCE AND CLIMATE CHANGE FRAMEWORKS

Office of Environment and Heritage Climate Change Fund Draft Strategic Plan (2017)

NSW Office of Environment and Heritage – NSW Climate Change Policy Framework (2016)

Resilient Sydney - Resilient Sydney, a strategy for city resilience (2018)

EMERGENCY RESPONSE

Office of Emergency Management, Heatwave Sub-Plan (2011)

State Level Emergency Risk Assessment (2017) features heat as a priority risk for NSW

EXAMPLE LOCAL HEAT STRATEGIES

Penrith Cooling the City Strategy (2015)

Parramatta Environmental Sustainability Strategy (2015)

GREEN INFRASTRUCTURE AND URBAN HEAT RESOURCES

Urban Green Cover in NSW Technical Guidelines (OEH, 2015)

Draft Greener Places, Green Infrastructure Policy, Office of the Government Architect, NSW (2017)

202020 Vision - National Strategy and Resources such as "How to Grow an Urban Forest," partnership led by Hort Innovation

CRC for Low Carbon Living - Guide to Urban Cooling Strategies (2017) and Cooling Western Sydney Plan (2017) (Collaboration with Sydney Water)

STRATEGY TARGETS

The strategy identifies the following targets (note that these are in a developmental stage and draw from existing literature, policy and strategies):

1. Increase multi-sectoral collaboration and investment to deliver more projects to address the impacts of urban heat in Western Sydney by 2023.

2. Reduce the average peak ambient temperatures in Western Sydney by 1.5°C through water, greening and cool materials strategies by 2023.

3. Zero net increase in economic impacts of heatwaves by 2023.

4. Zero net increase in morbidity and mortality impacts of heatwaves in Western Sydney by 2023.

Turn Down the Heat recognises five strategic drivers that represent the resilience outcomes that can be achieved through implementation of the strategy:

Take action together

Design and plan to cool the built environment

Innovative and responsive infrastructure

Cool with green space and water

Build a community that is healthy and prepared

Achieving the targets will need to be a collaborative effort with leadership at many levels. To enable this, the strategy proposes the formation of working groups to further develop the targets and advance priority actions and advocacy.

Contributions from residents to Penrith City Council's heat strategy

SECTION 2.0

THE NEED TO TURN DOWN THE HEAT IN WESTERN SYDNEY

2.1 URBAN HEAT IN THE WESTERN SYDNEY CONTEXT

While urban heat isn't unique to Western Sydney, it has a particularly significant impact due to the region's existing climate, its large and growing residential population, infrastructure, landscape and ongoing urban development.

Western Sydney is already experiencing the impacts of urban heat and heatwaves on its people, places, businesses, infrastructure, and environment. As the cost of heat is being felt across Western Sydney, momentum is building to take action to reduce the impacts of urban heat and capture the social, economic and environmental benefits associated with these actions.

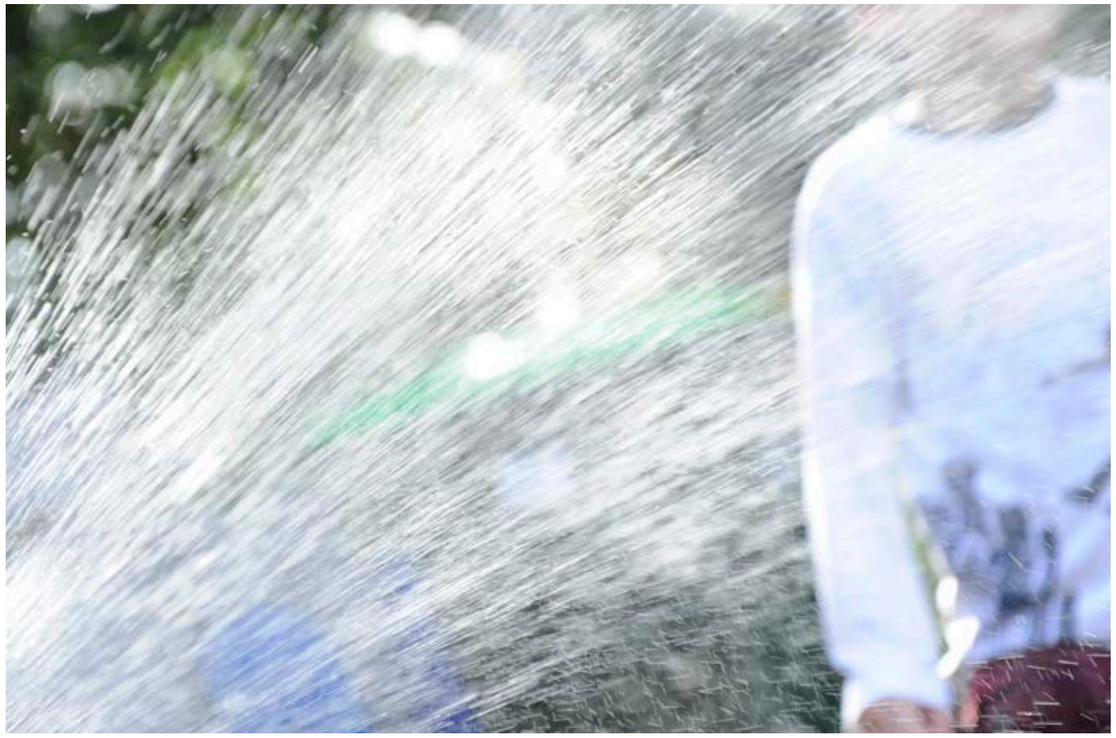
A GROWING, GLOBAL COMMUNITY

The Greater Western Sydney region covers a large area; stretching over 8,948km^2, ranging from densely populated metropolitan areas to rural lands and the World Heritage Area of the Blue Mountains.
Western Sydney is growing at an unprecedented rate.

This growth presents an opportunity to create thriving, liveable new communities, but if poorly managed, growth could have negative heat impacts on current and future residents. The Greater Western Sydney region's population of 2.4 million is expected to increase by 1 million to over 3.5 million by 2036.[4]

A number of social, economic and environmental factors influence Greater Western Sydney's exposure to the impacts of urban heat. Higher observed temperatures, increasing development intensity and a reduction in green infrastructure increase the urban heat island effect. Greater pressure on transport and health infrastructure, higher rates of chronic disease, a growing older population, pockets of economic disadvantage, as well as greater cultural and linguistic diversity increase the vulnerability of local populations to heat events.

Residents cooling down in Western Sydney



WESTERN SYDNEY AND THE IMPACTS OF HEAT

HEATWAVE IMPACTS ACROSS SYDNEY

During the 2011 heatwave across Greater Sydney, the Hunter and the Illawarra, impacts included:

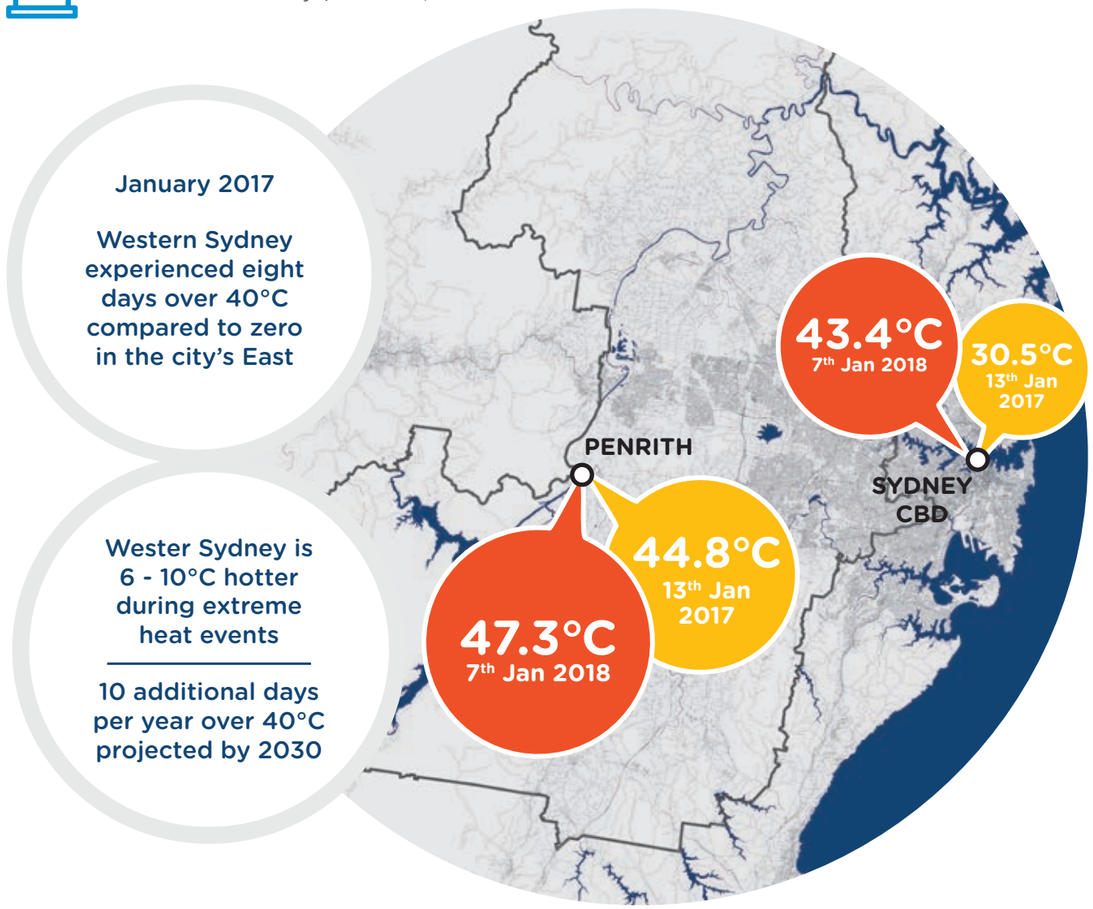
340
Emergency department visits for heat effects and dehydration as well as a 2% all-cause increase in emergency department visits

Peak electricity demand increases by almost 100% when temperatures increase from 20 °C to 40 °C

14%
more ambulance calls

Energy consumption for cooling purposes in Western Sydney is up to 100% higher than in the eastern zones of the city

13%
increase in mortality (96 deaths)



Source: Office of Environment and Heritage

Residents of Western Sydney enjoying a picnic

WHAT IS URBAN HEAT?

Urban heat island effect is the tendency of cities to be much warmer than their rural counterparts. Urban surfaces such as roads and roofs absorb, hold, and re-radiate heat; raising the temperature in our urban areas. This effect is often worsened by development activity when green spaces are replaced with more hard surfaces that absorb heat, such as the growth happening in Western Sydney today. Human activities such as traffic, industry, and electricity usage generate heat that adds to the urban heat island effect.

Urban heat is a more general term that refers to high temperatures that pose a risk to our communities and infrastructure. This report uses urban heat to refer to temperatures 28°C and higher because that is where negative health impacts are shown to begin.

Heatwaves are defined by the Australian Bureau of Meteorology as a period of three or more consecutive days of high maximum and minimum temperatures which are unusual for that location. Heatwaves are especially dangerous because prolonged exposure to heat is associated with greater health impacts when the body does not have an opportunity to recover and cool down.

Hot days	Defined by the Climate Council as days between 30°C and 35°C
Very hot days	Defined by the Climate Council as days between 35°C and 40°C
Extremely hot days/extreme heat	Defined by the Climate Council as temperatures 40°C and over

Key terminology

IT IS HOT AND GETTING HOTTER IN WESTERN SYDNEY

Aerial view of hew housing development in Western Sydney

URBAN HEAT IN WESTERN SYDNEY TODAY

Typically in Western Sydney, average maximum daily temperatures range from 28.5°C in summer to 17.4°C in winter. While Western Sydney experiences an average of 11 days per year above 35°C (BoM for Parramatta North Masons Drive, 2017), the table below demonstrates that Western Sydney has already experienced an increase in extreme temperature days in recent years.

Using Parramatta as an example, there has been a 12% increase in the average annual number of hot days (above 30°C) and a 27% increase in the average annual number of very hot days (above 35°C).

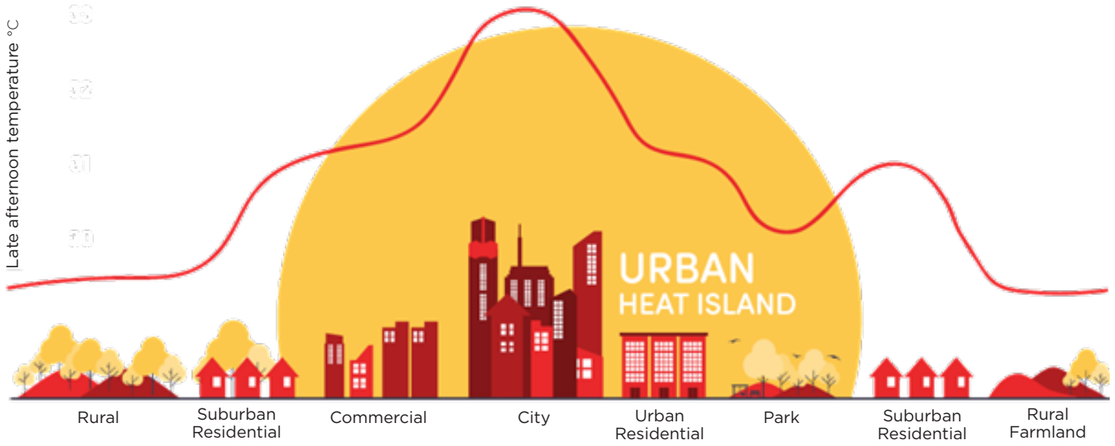
Analysis of temperature records over the last 40 years show that Western Sydney has seen a rise in annual temperatures above those experienced in coastal parts of the city. The gap between coastal and Western Sydney temperatures has widened, and the number of very hot days has increased in the West.[5]

Snapshot of daily maximum temperatures for recent years for Sydney, Parramatta and Penrith[6]

	YEAR					AVERAGE FOR ALL YEARS OF DATA
	2013	2014	2015	2016	2017	
SYDNEY (OBSERVATORY HILL)						**1859 – 2017**
Annual number of days above 30°C	19	18	23	28	30	14.8
Annual number of days above 35°C	5	2	7	6	12	3.1
Annual number of days above 40°C	2	0	1	0	0	0.3
PARRAMATTA						**1967 – 2017**
Annual number of days above 30°C	58	49	47	55	29	43.1
Annual number of days above 35°C	14	9	15	16	18	10.9
Annual number of days above 40°C	3	2	1	1	8	1.5
PENRITH						**1995 – 2017**
Annual number of days above 30°C	81	71	73	82	79	69.5
Annual number of days above 35°C	24	21	23	22	38	20.1
Annual number of days above 40°C	5	4	2	4	16	4.2

Note: temperatures are recorded in the shade and do not reflect the temperature in direct sunlight.

GOOD URBAN DESIGN CAN REDUCE THE IMPACT OF HEAT. WE NEED TO PRIORITISE 'COOL PLANNING' IN OUR CITIES.



Urban Heat Island Effect (Image credit: City of Parramatta)

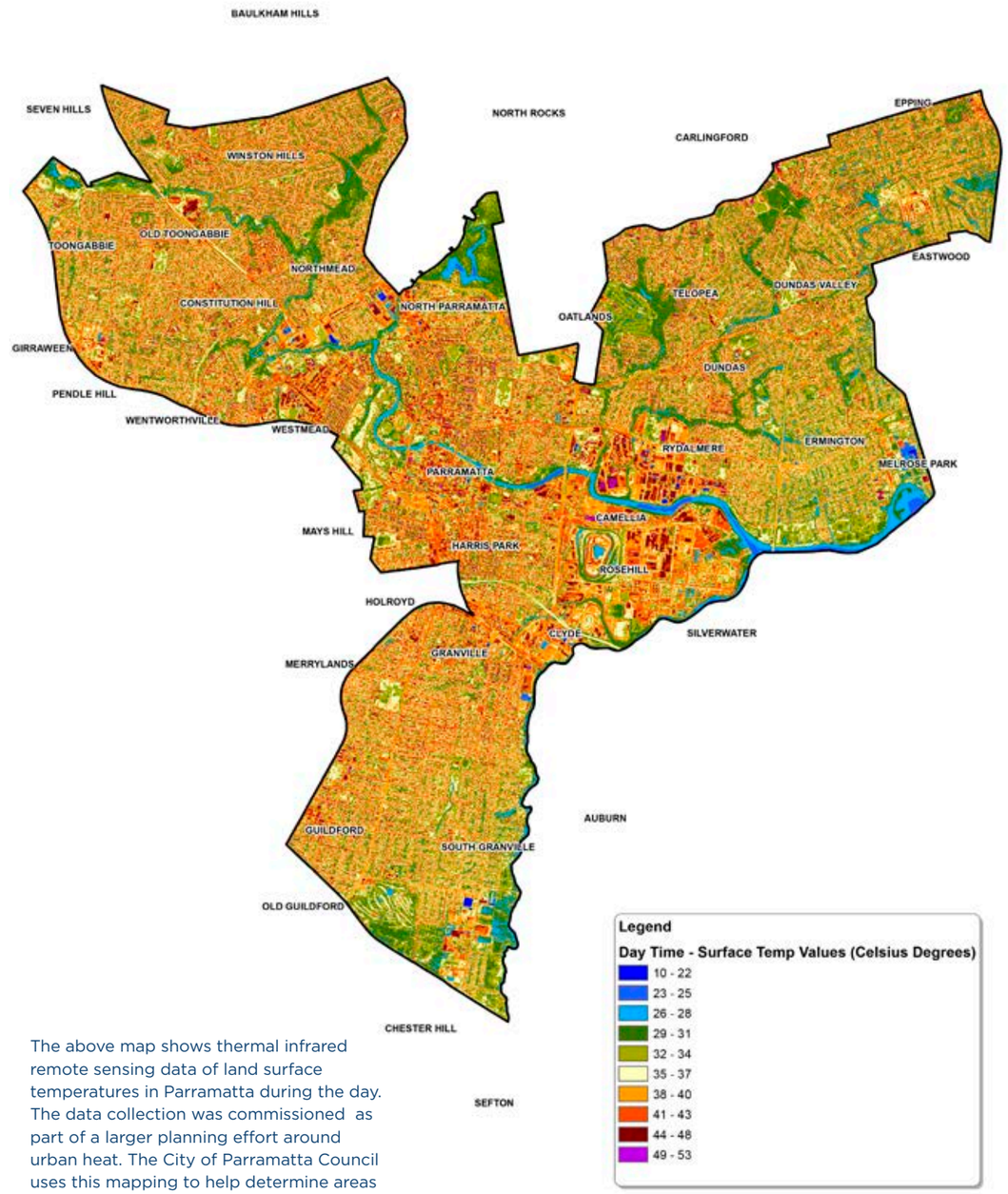
Urban heat island effect in Western Sydney

Higher temperatures in Western Sydney are due in part to geography and local urban heat effects, but can also be related to larger climate trends, such as global climate change and regional trends such as the large urban heat island over the Sydney Central Business District (CBD) that can delay and even block the inflow of the sea breeze into western parts of Sydney.

Urban heat is also created by the built form within Western Sydney. For example, in Parramatta, heat mapping was undertaken for the Parramatta CBD, and demonstrates the higher temperatures experienced by developed areas, and the influence water bodies and areas of landscaping and planting have on reducing the temperature.[7]

January 2018

Western Sydney experienced its hottest day since 1939 when temperatures in Penrith reached 47.3°C. Temperatures at Observatory Hill in the CBD reached 43°C. Energy providers expected significant stress on the national power grid in the heatwave, but despite some small localised outages impacting 14,000 customers, the grid held up.[8] Flying fox colonies south of Sydney did not fare so well, however, with hundreds of bats found dead from heat stress and dehydration.



The above map shows thermal infrared remote sensing data of land surface temperatures in Parramatta during the day. The data collection was commissioned as part of a larger planning effort around urban heat. The City of Parramatta Council uses this mapping to help determine areas where green infrastructure and other cooling projects are highest priority.

Parramatta Local Government Area Heat Map[7]

January 2017: Extreme heat, east and west

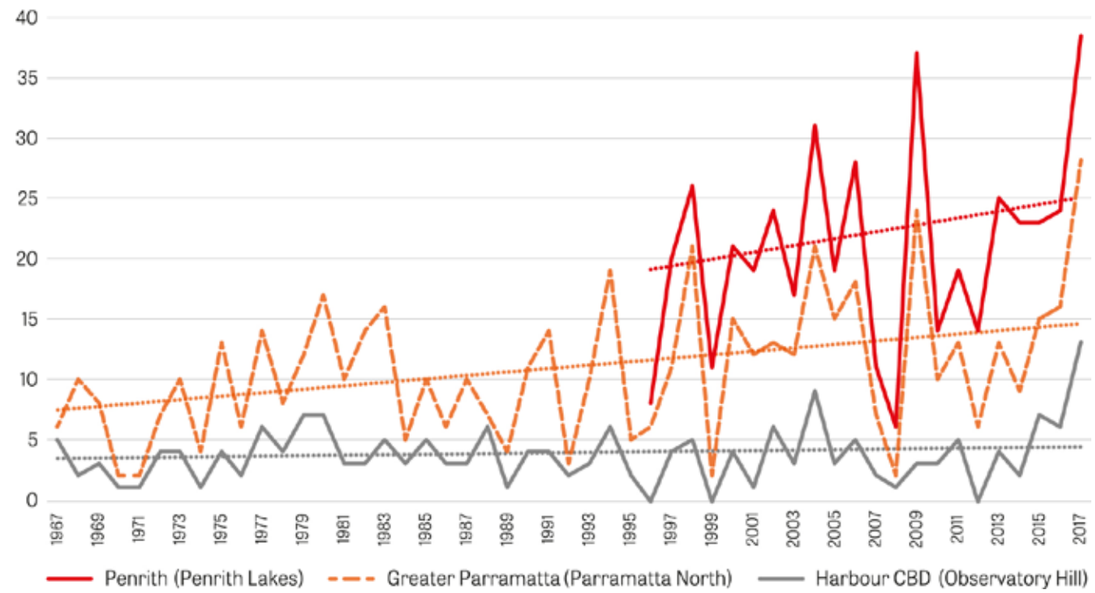
TEMPERATURE RANGE	NO. OF DAYS – SYDNEY (OBSERVATORY HILL)	NO. OF DAYS – WESTERN SYDNEY (PENRITH LAKES)
Hot days: 30°C – 34.9°C	6	4
Very hot days: 35°C – 39.9°C	5	7
Extreme heat: 40+°C	0	8
Total days above 30°C	11	19
Average temperature	29.6°C	33.9°C
Maximum temperature[9]	39.4°C	47°C

Note: temperatures are recorded in the shade and do not reflect the temperature in direct sunlight.

January 2017 was the hottest month on record in Sydney and can be considered a 'near miss' in terms of impacts on human health. While all of Sydney experienced high temperatures, Western Sydney locations recorded highs including 41.6°C in the shade at Blaxland Riverside Park at Sydney Olympic Park.[9]

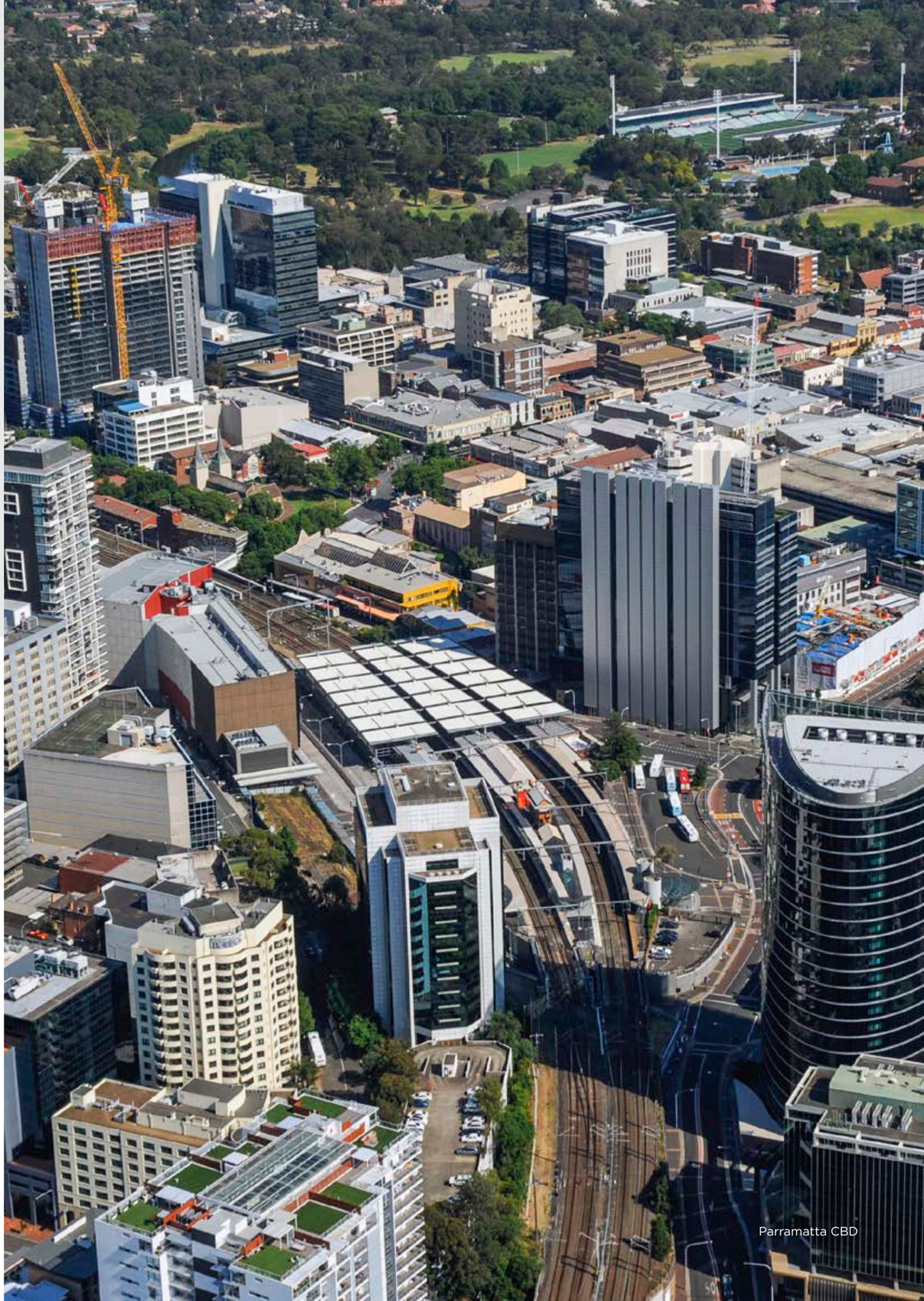
The table above[10] highlights the 31 days of January 2017 and shows the clear differences in temperature between the Sydney CBD and Western Sydney. Penrith experienced 10 days that were over 5°C hotter than Sydney – including the 13th of January when the difference in temperature was 14.3°C.

At the time of writing in January 2018, heat records are continuing to be broken.



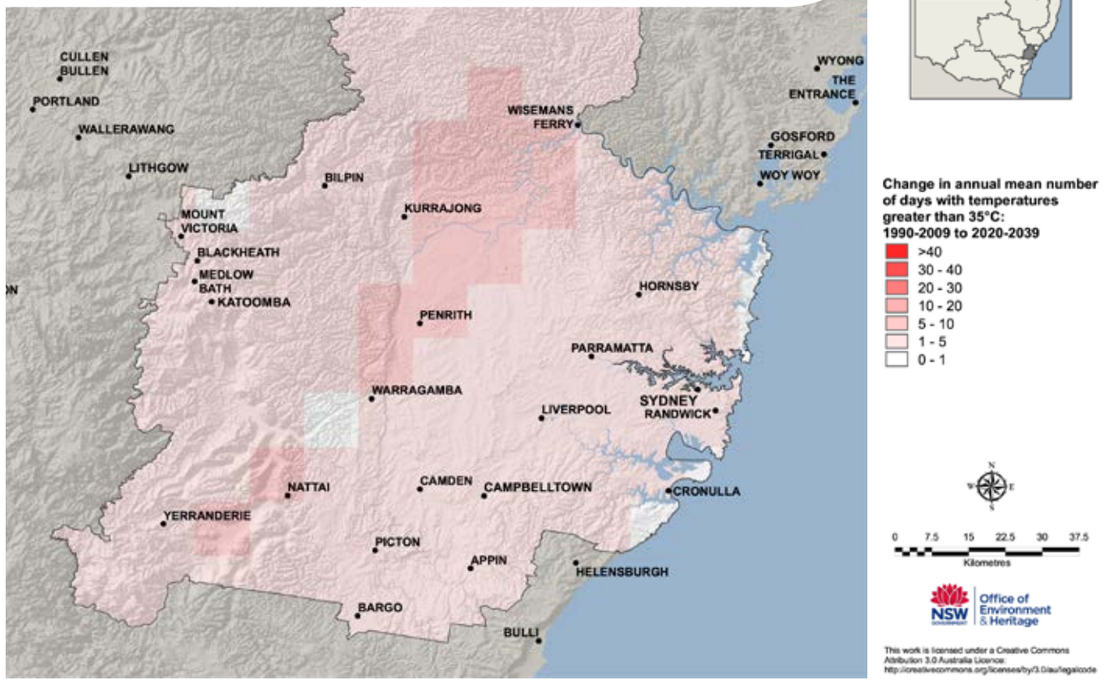
Source: Greater Sydney Commission (2018) using data from the Bureau of Meteorology

Number of days over 35° in Parramatta, Penrith and Sydney CBD



Parramatta CBD

WESTERN SYDNEY EXPERIENCES MORE EXTREME HEAT EVENTS, AND THESE ARE PROJECTED TO WORSEN. WE NEED TO ACT NOW.



2030 - Increasing number of days per year above 35°C

THE FUTURE OF URBAN HEAT – INCREASING IN SEVERITY AND FREQUENCY

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report[11] states with high confidence that Australia is already experiencing impacts from recent climate change, including a greater frequency and severity of extreme weather events. Other observed trends include an increase in record hot days, a decrease in record cold days, ocean warming and sea-level rise.

The impact of climate change on Western Sydney is expected to result in an increase in average, minimum and maximum temperatures and more hot days and fewer cold nights overall.

Maximum temperatures are projected to increase by almost 1°C by 2030 and by nearly 2°C by 2070. The greatest change in maximum temperatures is projected to occur during spring; increasing by up to 2.2°C by 2070. Minimum temperatures (overnight temperatures) are also projected to increase by up to 2°C in the far future[12]. Increased overnight temperatures will result in considerable health impacts, due to a lack of respite from the heat.

Climate modelling undertaken by the NSW Office of Environment and Heritage's (OEH) Adapt NSW program further indicates Western Sydney will face an additional 5 – 10 extremely hot days in the near future, rising to up to 20 additional hot days per year by 2070.[13]

Additionally, OEH predicts that the conversion of forests and grasslands in the north-west and south-west of Sydney to new urban development may double the projected temperature increases from climate change in the near future.[12]

The projected changes in climate in Western Sydney stand to increase the physical impacts on the infrastructure and services that shape our communities as well as the people who live and work within them.

2.2 IMPACTS OF URBAN HEAT ON OUR PEOPLE, INFRASTRUCTURE, ECONOMY AND ENVIRONMENT

IMPACTS OF URBAN HEAT ON OUR PEOPLE

Heatwaves impact every single resident of Western Sydney, but those impacts are not evenly distributed. They particularly impact the elderly, children, and those with existing medical conditions. Heatwaves can worsen existing illnesses (morbidity) and can cause death (mortality).

Western Sydney is particularly vulnerable to the impacts of urban heat due to:

- Higher numbers of people living in Western Sydney with existing chronic illnesses.
- An aging population which is more vulnerable to the impacts of heat.
- Health infrastructure which is under pressure due to a growing population.
- A higher proportion of residents with lower incomes who are more vulnerable to the increasing costs of keeping their homes cool during heat.
- An existing lack of public transport infrastructure means that walkability on hot days is more impacted, reducing connectivity, increasing transport by private vehicle which increases the economic burden of transport and associated carbon emissions, and negatively impacting active transport and health.
- Several districts defined by the Australian Bureau of Statistics as falling into the most disadvantaged 10% of districts in the country according to the Socio-Economic Indexes For Areas (SEIFA) are in Western Sydney.

Residents of Western Sydney cooling off in the heat

HEAT IMPACTS OUR HEALTH. WE NEED NEW APPROACHES TO SAVE LIVES AND REDUCE THE BURDEN ON OUR HEALTH SYSTEM.

Heat and mortality

Periods of extreme hot weather can lead to an increase in mortality especially in the elderly. A study of emergency hospital admissions in five regions in NSW – Sydney East and West, Illawarra, Gosford-Wyong and Newcastle in 2011 – showed that on extremely hot days there was an increase in heat related injuries such as dehydration. Those with existing conditions such as cardiac and respiratory diseases, and mental health problems are more susceptible to heat-related injury and death. Workers at risk from exposure to extreme heat include those who work outdoors, such as construction workers and builders; maintenance workers; farmers and emergency and essential service providers[5].

Emergency department admissions during heatwaves

From January 30-February 6, 2011, New South Wales was affected by an exceptional heatwave, which broke numerous records. Near real-time Emergency Department (ED) and ambulance surveillance allowed rapid detection of an increase in the number of heat-related ED visits and ambulance calls during this period. During the heatwave there were 104 and 236 ED visits for heat effects and dehydration respectively, and 116 ambulance calls for heat exposure. From the regression model, all-cause ED visits increased by 2%, all-cause ambulance calls increased by 14%, and all-cause mortality increased by 13%. Those aged 75 years and older had the highest excess rates of all outcomes[2].

THE HEALTH IMPACTS OF HEAT

Heatwaves kill more Australians than any other natural disaster, more deadly than storms, fire and floods combined.[14] Furthermore, the region's projected population growth will significantly increase the number of people and therefore the region's vulnerability to heat.

In exploring the costs associated with extreme heat and heat related impacts we can see that between 1987 to 2016 in Australia over 500 people lost their lives as a result of heatwaves and a further 2,800 recorded injuries. When the impact from bushfires is factored in, this figure rises to around 730 fatalities and nearly 4,000 injuries over the same period.[14]

People over 65 are especially vulnerable to the impacts of heatwaves. This is due to age related decline in the ability to regulate body temperature. Heat contributes to the deaths of over 1,000 people aged over 65 across Australia each year.[15] This impact is particularly concerning in the context of Australia's increasingly aging population and the fact that only half of aged care facilities across NSW have a heatwave response plan.[16] As well as those aged over 65, those most at risk include the very old, the ill, the very young, and those who work outdoors or whose physical and mental wellbeing are compromised.[17]

The death rate from heat related causes is likely to increase with population growth, ageing and climate change. Research also confirms that aggressive behaviour and substance abuse can increase on extremely hot days. Furthermore, given that psychological disorders already affect the lives of millions of individuals, the social and economic costs resulting from heatwaves on families, communities and industries will continue to increase.[18]

Chronic illness rates are higher in the Western Sydney region. Across Metropolitan Sydney, around 50% of the population is overweight or obese, parts of western Sydney have higher rates such as 55% in the Nepean-Blue Mountains. Western Sydney also suffers much higher rates of type 2 diabetes; a condition that is two to three times more prevalent in Western Sydney than the Sydney CBD.[20]

Chronic disease is often difficult for individuals to manage, but it also puts extreme pressure on the region's hospitals and health services, and makes its sufferers more vulnerable to the adverse impacts of heat.[19] Many of the factors which influence an individual's lifestyle choices – including environment, education and employment – lay outside the traditional health sector. Access to frequent and reliable public transport, open green spaces, health education, better access to healthy food and reduced commute times all make it easier for individuals to live healthier lifestyles, and many of these factors are directly tied to how an individual experiences urban heat.[18]

WE NEED TO BETTER MANAGE THE IMPACTS OF HEAT ON THE SYSTEMS OF OUR CITIES TO PREVENT CASCADING FALLOUTS.

Heat-related illness is also likely to worsen and the risk of respiratory problems will increase. Extreme heat exacerbates air quality issues such pollution from vehicle emissions, industrial fumes and bushfires as well as increased ground-level ozone and dust and pollen levels.

IMPACTS OF URBAN HEAT ON OUR INFRASTRUCTURE

Of all extreme weather events, heatwaves place the greatest pressure on city assets. Heatwaves cause energy, water and health demands to soar. Downstream economic impacts such as higher energy costs and agricultural losses are also a serious consideration.

Resilient Sydney[21] has recognised Metropolitan Sydney's vulnerability to extreme weather events; in particular, heatwaves are recognised as the single biggest threat to Metropolitan Sydney. As part of the extensive research and collaboration undertaken to develop the Resilient Sydney Strategy, the program identified flow on effects arising from extreme heat events (e.g. power failure; transport disruption; burden on the health system) as having the capacity to bring parts of the city to a standstill and disrupt both lives and livelihoods.

The infrastructure and essential services we depend on each day, such as energy and water, are also at risk in a heatwave. Peak electricity demand increases by almost 100% when temperatures increase from 20°C to 40°C[3] as use of air conditioning increases across the city. Continuity of essential services is often the difference between life and death in a severe heatwave. Power outages can lead to deaths when vulnerable populations are without air conditioning.

Residential electricity use can be three to four times higher than normal on days 35°C and hotter,[22] placing further stress on the power grid.

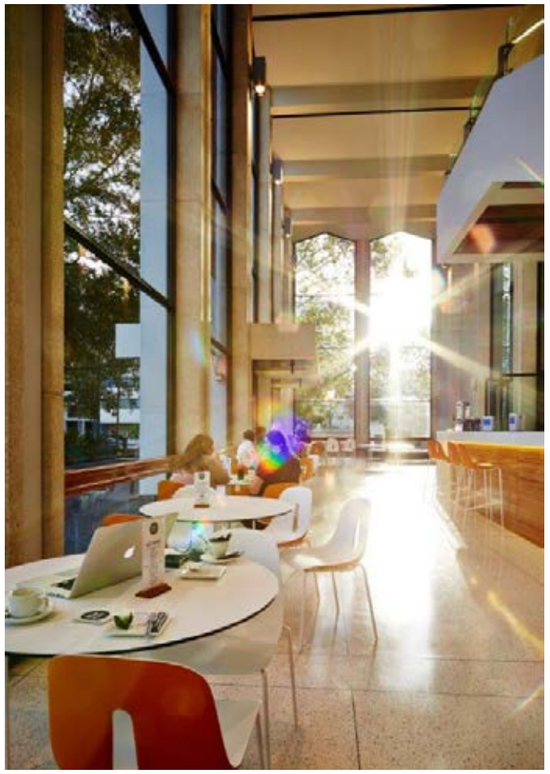
Controlling energy demand is one way to avoid blackouts; Endeavour Energy and other power companies enrol residents in an incentivised demand management program to bring power use down on high power outage risk days.

Initiatives to assist residents in reducing their overall electricity usage are also critical.

Economic benefit of increased tree cover

Research undertaken by AECOM that focused on three Sydney suburbs (Blacktown, Willoughby and Annandale) has led to a conservative estimate that just a 10% increase in the leaf canopy of street trees could increase the value of properties by an average of $50,000.

Looking at the Sydney suburb of Blacktown, findings indicated that a 10% increase in the size of the canopy across the suburb showed an increase in the value of property of 7.7%, or $55,000 for the average house.[30]



Western sun in Western Sydney

WE KNOW THERE ARE ECONOMIC IMPACTS OF HEAT, BUT WE NEED MORE RESEARCH TO QUANTIFY THEM.

IMPACT OF URBAN HEAT ON OUR ECONOMY

While intuitively, the economic burden of heatwaves is significant, the exact cost to our communities remains unknown and challenging to quantify. In addition to the impacts on health services identified in the previous section, reduced labour and economic productivity has been observed, along with a heightened demand on emergency services, infrastructure stress and breakdown, and agricultural losses.[17]

A new report published by the Australian Business Round Table on Disaster Resilience and Safer Communities, confirms this data gap and acknowledges that while heatwaves have caused more deaths across Australia than any other type of natural disaster the absence of direct, tangible costs to property and infrastructure renders their impact hard to measure because heat impacts are not insurable.

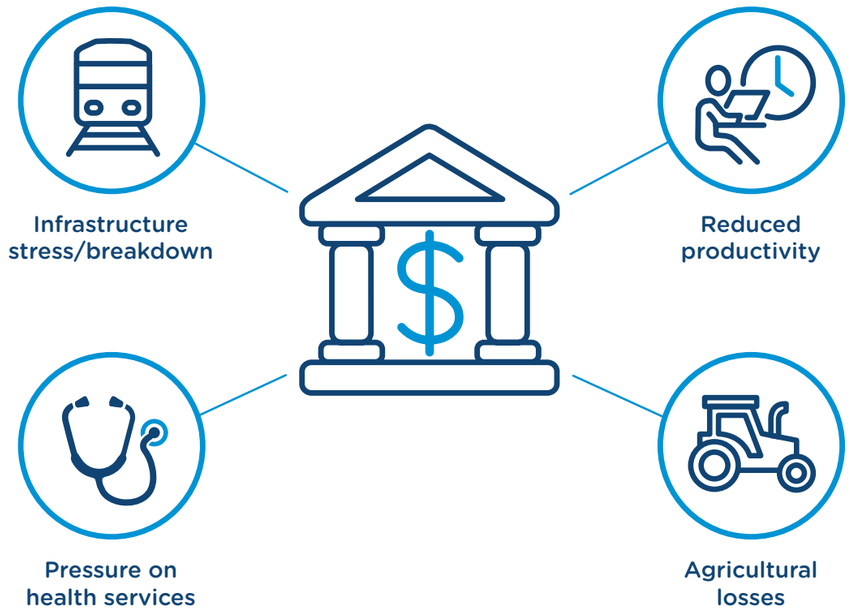
ECONOMIC LOSSES IN A POWER OUTAGE

While the economic costs of power outages in New South Wales are not well-documented or projected, the blackouts in September 2016 in South Australia cost businesses $367M when storms swept the region and caused failure of the electricity network in several places. The calculation included lost production, lost trading, and wages paid despite not being in operation. Higher participation in business interruption insurance could help alleviate these types of losses in the future.[23]

Economic impacts of heatwaves in Victoria

Heatwaves have immense costs to our community, especially loss of life. Without adaptation, it has been estimated that heatwaves could cause an additional 6,214 deaths (or 402 deaths annually) by 2050 in Victoria alone. This translates to an additional $6.4 billion loss or $218 million per year.[17]

EXAMPLES OF ECONOMIC IMPACTS OF URBAN HEAT



WE NEED TO REDUCE THE IMPACT OF EXTREME HEAT ON OUR ENVIRONMENT, FLORA AND FAUNA.

IMPACT OF URBAN HEAT ON OUR ENVIRONMENT

Extreme heat causes stress to trees and vegetation, especially when combined with drought conditions. The Clean Air and Urban Landscapes Hub report, Risks to Australia's Urban Forest from climate change and urban heat, found that 14% of all public trees (22% of species) in Australia's cities are at high risk from increased temperatures in the emissions limited climate change scenario, and 24% of all public trees (35% of species) in the business as usual emissions scenario by 2070.[24]

While the impact of extreme heat on people and vulnerable communities is well documented and discussed, impact to animals has been less emphasised. Both pets and wildlife often suffer in extreme heat events.

An example of this was seen during the summer 2017 heatwave where thousands of bats died during the peak of the heatwave. Bats begin to struggle when temperatures exceed 42°C and large die offs in the bat population can also have reverberating ecosystem impacts on pollen and seed dispersal.[25]

Changing climates can lead to shifting habitat zones and breakdowns in crucial ecological cycles. These shifting habitat zones, combined with loss of habitat due to an increase in development, can have tremendous impacts on the health of animals and plants in the natural environment.

Birds experiencing heat stress during an extreme heat event in Western Sydney. Credit: Lenore Gee

2.3 TOWARDS A COOLER FUTURE

Urban heat impacts every individual and system across Western Sydney. Because these impacts are so significant, momentum is building around mitigation and adaptation to urban heat across a very diverse range of organisations.

While the true cost of urban heat and heatwaves is not yet quantified on a national or regional level, there is emerging clarity around the social, economic and environmental benefits that come from addressing urban heat.

Reducing the risks and impacts of urban heat as Western Sydney grows presents a tremendous opportunity to build upon existing momentum and collaborate as a region to realise diverse benefits from adaptation efforts.

For example, adaptation efforts that create a greener Western Sydney will help to cool our urban areas, but trees also have myriad other benefits including improved physical and mental health of residents, increased property values, and improved air and water quality.

A detailed action plan outlining specific actions and specific benefits realised by those actions in reducing urban heat and creating a more livable Western Sydney can be found in the following section.

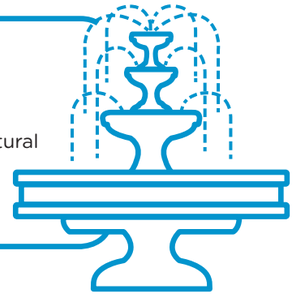
WE NEED TO WORK TOGETHER TO MANAGE HEAT IMPACTS.

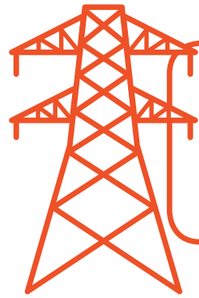
URBAN COOLING STRATEGIES

Listed below are key actions to address the issue of extreme heat. Not one of these interventions alone can solve the issue of heat, all are critical and interlinked. The effectiveness of any strategy will vary according to the location, urban context, geography and climatic zone.

Designing with water

Water is one of the most effective ways to cool an urban environment. Designing with water can consist of a mix of natural water bodies, fountains, ponds, and technologies to integrate urban evaporative cooling systems.



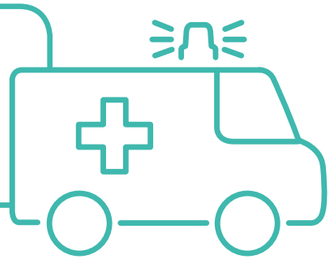


Infrastructure adaptation

Preparing our city's infrastructure to cope with extreme temperatures is critical for our economy and to ensure the community has access to cooling, water and transport when they need it most.

Emergency and health response

While mitigation is crucial, we must also prepare for extreme heat events and heatwaves by ensuring we have appropriate emergency and health responses in place.

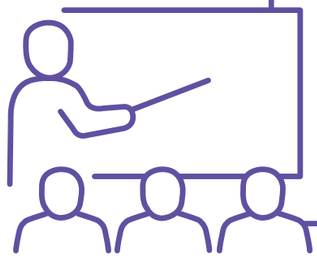


Greening urban areas

Urban canopy cover and green spaces contribute to shade and evapotranspiration. Species selection, planting location and maintenance are critical to ensure optimum cooling benefits.

Education

It is critical that communities understand the health risks of extreme heat and can take action accordingly. Ensuring that people stay healthy and look out for others, but also equipping communities with the knowledge and resources to minimise their contribution to the problem.



Cool materials

Building materials are major contributors to the urban heat island effect. They store heat and by doing so reduce indoor and outdoor thermal comfort. Choosing materials that prevent solar radiation (heat) from being absorbed can make a significant difference. Examples include light coloured roofs or pavers.

Research

We must continue to build our understanding of impactful interventions and ensure information is accessible to key decision makers.

SECTION 3.0

A COLLECTIVE RESPONSE

SECTION 3: A COLLECTIVE RESPONSE

This section of the strategy outlines our collective response to the problem of urban heat. It contains an overview of existing actions underway in Western Sydney today and proposes a series of actions to mitigate and adapt to urban heat. Together, they represent a more coordinated approach to urban heat mitigation using both existing and new opportunities, adopting a cross disciplinary network and multi-sector strategy to work towards a cooler, more liveable and resilient future.

3.1 EXISTING WORK ACROSS WESTERN SYDNEY TO ADDRESS HEAT

This strategy would not be complete without acknowledging the tremendous work already underway in Western Sydney surrounding the issue of urban heat. Research and engagement leading to the creation of this strategy involved identifying best practices globally and across the region and understanding where those successful projects, programs and policies might be scaled up or aligned to have a greater impact.

For example, Building Resilience to Climate Change grants funded by the NSW Office of Environment and Heritage have helped initiate innovative pilot projects and testing of mitigation techniques for urban heat that are bringing the field forward. Researchers across the academic community including Western Sydney University and the CRC for Low Carbon Living are studying the ways in which urban heat impacts our minds, bodies, and our communities, providing a growing evidence base to inform policy and decision making. Local governments throughout Metropolitan Sydney are tackling urban heat through everything from tree giveaways to adjustments to their Development Control Plans.

Mitigation and adaptation

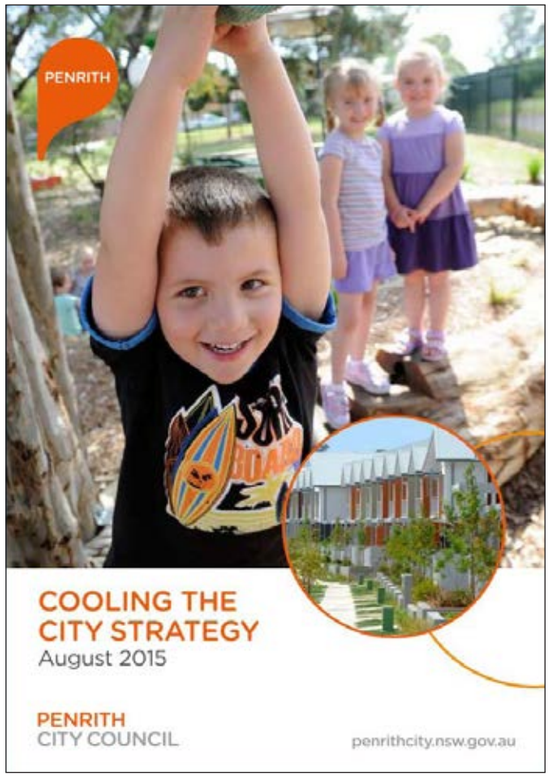
Mitigation includes actions that seek to reduce the root cause of urban heat, through either an increase in green canopy, changes to urban form and design, changes in building and paving materials, or use of irrigation and water features. Mitigation actions can also include reducing carbon emissions that are driving local and global climate change.

Adaptation actions are designed to reduce the impact of urban heat and help residents and organisations better cope with the impacts of heat.

Actions included in this strategy consider both mitigation and adaptation.

At a national scale, a vision for a greener Australia is supported through several different initiatives. The 202020 Vision partnership, led by a Horticultural Innovation grant, sets an inspiring vision for a 20% increase in urban green cover by 2020 and has also produced important resources for green infrastructure advocacy and leadership. Furthermore, the Australian Government National Landcare Program's 20 Million Trees Grant funds tree planting projects.
The Commonwealth Scientific and Industrial Research Organisation (CSIRO) research projects include development of a cost benefit tool to assess the business case for urban greenery and a project to understand and overcome cultural barriers to urban greenery. CSIRO also has a living lab at Sydney Science Park to test and monitor urban innovations, including urban heat mitigation techniques. Conservation Volunteers Australia supports urban strategy "health communities" and one key component is forming partnerships to mitigate urban heat effects via managed groups of volunteers to undertake practice conservation activities. Finally, the Green Building Council of Australia (GBCA) Green Star Rating System offers urban heat credits for planning and design for cooler urban environments.

The following three pages outline key examples of actions already occurring to mitigate or adapt to urban heat in Western Sydney.



Penrith Cooling the City Strategy outlines actions to reduce temperatures in Penrith

The Cool Parramatta website provides tips on how to stay cool

Two examples of urban heat strategies from within the Western Sydney region are presented below.

PENRITH – COOLING THE CITY STRATEGY

In 2015, Penrith City Council released the Cooling the City Strategy which creates a framework for addressing the impacts of urban heat. The strategy is centred on the important role of improving existing urban areas as well as considering how opportunities to address urban heat can be adopted for new development areas as well. Actions include extensive tree planting over the next three years, a street tree inventory in suburbs with particular heat challenges, community and council staff engagement and education, building design, and a partnership with research organisations to construct climate adapted bus shelters.

COOL PARRAMATTA

Urban heat has been identified as a focus area within the City of Parramatta Environmental Sustainability Strategy 2017 which has set a specific goal to improve liveability by cooling the City and protecting people and communities from heat stress by expanding the urban canopy and green space and designing with water.

City of Parramatta has also launched the 'Cool Parramatta' initiative[26], a strategy to combat urban heat within Parramatta. The strategy includes opportunities for users to sign up and receive tips on how to stay cool as well as promotional offers from local businesses that relate to cooling off. A range of data has been made available, including interactive heat maps for Parramatta. Recognising that young children, the elderly and those with a chronic illness are generally more at risk during heatwaves, members of the community are also encouraged to sign up as a 'heat buddy'. The Cool Parramatta initiative has been developed in partnership with the Western Sydney Local Health District.

A SAMPLE OF EXISTING WORK TO TURN DOWN THE HEAT IN WESTERN SYDNEY

This strategy sought to identify best practices across the region and to understand where those successful projects, programs and policies might be scaled up to have a greater impact. Below are some of the actions currently taking place across the region to green our urban areas, reduce the risk of heatwaves, and make Western Sydney a thriving, more liveable place.

1. Blacktown

Blacktown City Council

- Eyes on Blacktown transport link greening project, 2015
- Hydrating Bungarribee, pilot project investigating a potential method to ensure suitable and secure water supply to Bungarribee Park's green infrastructure by using treated wastewater.
- Community Greening Program Evaluation, 2004
- Member of CRC for Water Sensitive Cities
- Collaboration with RMS to plant large trees
- With OEH Support, Blacktown Showground Precinct (Francis Park) allows for water play lake/wetlands, walking paths, community garden
- Cool Streets Blacktown – a community engagement street tree planting project.

Blacktown and Mt. Druitt Hospital Expansion Project: Urban heat and health impacts features in arts and culture planning for Blacktown hospitals expansion

2. Blue Mountains

In partnership with Sydney Water, the Blue Mountains Council has installed various water fountains/filling stations

3. Canterbury Bankstown

City of Canterbury Bankstown

- Biodiversity plan sets ambitious goal for 30% increase in green canopy
- Tree offsetting policy requires replacement of existing trees
- Local Environment Plan contains energy incentive provisions for certain businesses
- Implementation of town centre plans will increase green coverage and walkability
- Stormwater harvesting treatment and reuse systems replacing potable water use for park management

4. Camden

Camden Council has focused on reducing urban heat with greening efforts in the southwest growth areas that identify and conserve vegetation through zoning and vegetation and voluntary planning agreements (VPA)

5. Campbelltown

Campbelltown City Council recognises the impact of heatwaves as a key resilience challenge in their Community Strategic Plan, Campbelltown 2027 (2017)

6. Cumberland

Cumberland Council

- Reviewing Local Environment Plan and development control plan to better address environmental issues
- Development of Environmental Management Framework and Biodiversity Strategy underway
- Free tree Giveaway program
- Water filling station installations

7. Fairfield

During heatwaves, Fairfield City Council provides free entry to its water park, Aquatopia

8. Hawkesbury

Hawkesbury City Council has prepared an Adaptation Action identifying 16 key adaptation actions, many of which aim to reduce the impacts of urban heat

9. Liverpool

Liverpool City Council is addressing urban heat in many ways, including:

- Developing street tree policy for city centre
- Planting programs for open space areas and streets

10. Parramatta

City of Parramatta Council

- Cool Parramatta digital engagement campaign to educate residents on how to keep cool
- Development control clauses that regulate building materials and landscape coverage
- Undertook a microclimate study for large precinct development at Parramatta Square
- Parra-ways walking strategy links green cool spaces with priority walking routes

11. Penrith

Penrith City Council

- Cooling the City Strategy – urban heat strategy published in 2015
- Deliver a range of activities to engage the local community with trees and greencover, including One Tree Per Child to childcare centres, plant giveaways, and interactive activities at community events
- Beat the Heat messaging before and during heatwaves

12. The Hills Shire

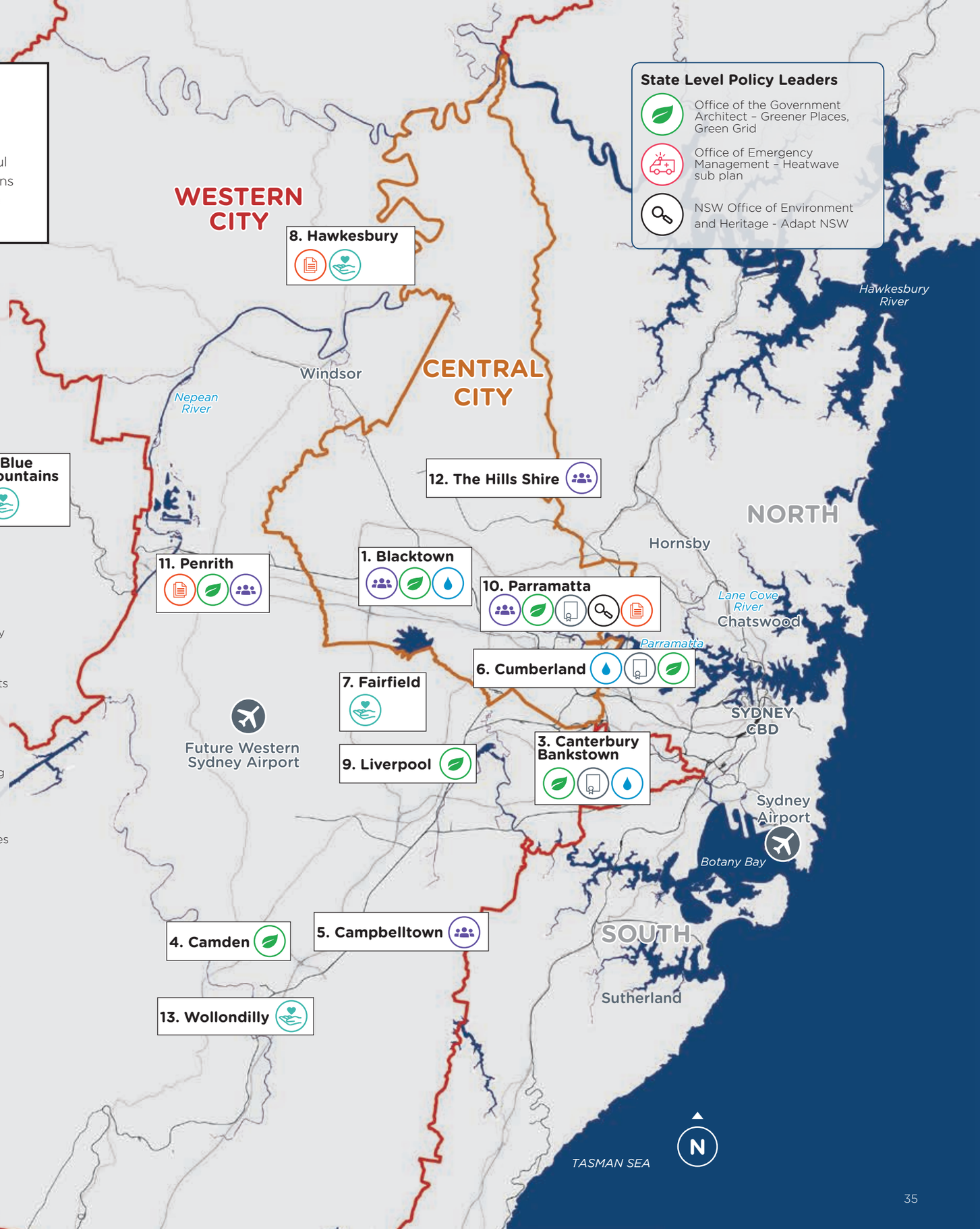
The Hills Shire Council provides free environmental workshops educating communities as to how to cope with the heat

13. Wollondilly Shire

Wollondidlly Health Alliance Social Planning Strategy includes recommendation for outreach on the impacts of heat

ACTION TYPES

Emergency response
Urban heat strategy
Advocacy
Green infrastructure
Designing with water
Policy/ development controls
Research
Community engagement
Building retrofits
Health and amenity



3.2 A PLAN FOR ACTION

Our vision for Turn Down the Heat is to catalyse action and enable government, business and the community to take local, practical and coordinated action on urban heat in Western Sydney to make our communities cool, liveable and resilient.

The following section outlines the priority actions identified for the Turn Down the Heat Strategy and action plan and provides a roadmap for delivery. Building the resilience of Western Sydney to cope, adapt and respond to urban heat will require a multi-faceted approach. Actions outlined in this strategy respond to needs across a range of topic areas and across multiple sectors, agencies and organisations.

Priority actions have been identified to build upon and fill gaps in existing actions to mitigate heat as well as bring new partners together to collaborate and share knowledge and experiences. Priority actions will be further developed by the proposed working groups (Refer to section 3.4 for more detail on next steps and governance). Implementation will be most efficient where the actions proposed can be incorporated and accommodated within existing organisational frameworks or processes, and opportunities to do this have been identified where possible. Similarly, the actions have been designed to acknowledge that creating new organisational infrastructure for a program or project is time consuming and costly. These actions look to leverage the existing roles played by various business, state and local organisations in addressing urban heat.

Where relevant to proposed actions, case studies have been identified to provide guidance on implementation in a local context. Similarly, to reflect the complexity associated with the delivery of a regional response, barriers and challenges to implementation have been identified, along with proposed solutions.

The priority actions were identified and prioritised by 180 stakeholders over two workshop forums, based on fulfilment of strategic drivers, existing actions and capacity, and feasibility of implementation. Benefit to vulnerable populations and ability to positively contribute to addressing equity in Western Sydney were also considered as part of the prioritisation exercise.

It will be important for all actions described in this strategy to be implemented with a lens of inclusivity. The needs of Western Sydney's vulnerable populations must be represented in all design processes for built projects and in planning efforts of new programs. For example, cool spaces should be accessible to residents of all mobility levels. An inclusive design process will increase participation in programs and use of public spaces will increase, allowing for maximum return on resources invested.

STRATEGIC DRIVERS

The action plan is organised around five strategic drivers that represent the resilience outcomes that can be achieved through implementation of this strategy.

Take action, together

Leaders across diverse organisations and institutions at the local, state, and federal level must raise awareness and promote action around the issue of urban heat. This will include sharing and celebrating best practice examples and success stories in order to build our collective capacity to respond. This action seeks to go beyond the traditional definition of leadership; in fact, stakeholders can each act as champions within their organisations and spheres of influence, to further develop and implement those actions to reduce the impact of urban heat across Western Sydney.

Design and plan to cool the built environment

This strategic driver explores the opportunity to reduce the built environment's contribution to urban heat. If achieved, this driver will alter the way that the built environment is managed, maintained and delivered. Changes to regulatory policies will influence the planning and design outcomes of hundreds of development projects underway in Western Sydney today.

Innovative and responsive infrastructure

The focus of this driver is working toward reliable critical infrastructure that can withstand heatwaves to provide essential services to all residents and businesses in Western Sydney. Additionally, these service providers support residents' day-to-day lifestyle and transportation needs.

Cool with green space and water

Western Sydney's parks, waterways and green spaces provide welcome and cooling relief on hot days allowing people to relax, play and interact within the public realm. There are significant opportunities to cool existing public and private spaces and ensure that future spaces are designed with urban heat in mind. To increase the provision of cool spaces we need to expand our collective understanding and practice of urban greening and water sensitive urban design to encompass health, affordability, amenity, community acceptance, maintenance and infrastructure.

Build a community that is healthy and prepared

An engaged, prepared community will be supported by an emergency response framework based on an improved understanding of at-risk populations and accurate forecasting of urban heat events. Education and communications also have a significant role to play in community preparedness. A fully engaged Western Sydney community, especially those vulnerable to urban heat, will better understand the risks of urban heat and ways to prepare and reduce risk.

3.3 ACTIONS TO TURN DOWN THE HEAT

As part of the strategy development process, 180 stakeholders from 55 organisations worked to identify and prioritise the proposed actions from a long list of existing actions informed by a desktop study and 20 interviews with key stakeholders. The following actions are those proposed as most critical for mobilising action to Turn Down the Heat across Western Sydney.

STRATEGIC DRIVERS AND PRIORITY ACTIONS		2018	2019	2020	2021	2022	2023	2024
Take action together								
1. Urban heat - state of the issue study	A scoping study will clearly outline the existing evidence base and targets for urban heat mitigation and adaptation measures and create access for decision makers to relevant data sets.							
2. Urban heat research consortium	Establish an annual urban heat research summit that brings together academics, industry, and local government to discuss critical gaps in research around the topic of urban heat and to facilitate relationships across traditional boundaries.							
3. Monitoring and evaluation of proposed actions	Develop project specific monitoring and evaluation programs to ensure that actions are evidence based and progress is measured, which will allow resources to be put toward the most effective actions.							
Design and plan to cool the built environment								
4. Land use and design controls that prioritise resilience	Appropriate changes to building codes, land use, development and design controls to prioritise green space and green infrastructure.							
5. Existing building retrofit programs	A program to retrofit existing buildings will include funding and outreach around cool roofs and improved home insulation.							
6. Social housing retrofit program	Collaborate with social housing providers to work toward appropriate retrofits to social housing, such as installing appropriate cooling units for vulnerable residents.							
Cool with green space and water								
7. Adoption of Sydney's Green Grid	Support greater adoption and collaboration to implement the Greater Sydney Green Grid, which promotes the creation of a network of high quality open spaces that supports recreation, biodiversity and waterway health and connects strategic, district and local centres, public transport hubs, and residential areas.							
8. Urban forest strategy	Management of Western Sydney's urban forest requires a coordinated and clear strategy for keeping trees healthy in stress conditions and for identifying and supplementing areas that lack adequate tree canopy.							
9. Recognition of blue and green infrastructure as critical urban infrastructure	Integrate construction and maintenance of blue and green infrastructure and the urban tree canopy into investment and maintenance planning. Recognise and invest in green infrastructure to the same level as hard infrastructure, to maintain the cooling capacity and other benefits of green infrastructure.							
10. Green infrastructure planning	Increase and expand green infrastructure on public land, in particular by developing sustainable funding sources and maintenance programs.							
Build a community that is healthy and prepared								
11. Preventative heat response framework	Develop a preventative heat response framework to integrate emergency management procedures and preparation with outreach to the community service providers that interact with vulnerable populations.							
12. Urban heat community engagement strategy	Develop a regional community engagement strategy for Greater Western Sydney to raise awareness around the dangers of heatwaves, inform decision making, and help create more prepared, resilient communities.							
13. Urban heat risk and impact research	Coordinate appropriate research projects to understand community and social impacts of disaster, inform better decision making, and provide an evidence base to justify investment in action.							
Innovative and responsive infrastructure								
14. Critical infrastructure provider forum on urban heat	Facilitate collaboration between utilities, infrastructure and essential services providers in Greater Western Sydney, and better clarify roles in continuity of services and interdependencies during urban heat events.							
15. Climate adaptive transport infrastructure and services	Raise awareness among transport infrastructure providers regarding the role of transport to keep people cool and opportunities to provide places of respite during urban heat events.							
16. Development of innovative funding models for cooling	Explore application of value capture principles to understand the beneficiaries of urban cooling infrastructure and how they might contribute to its construction.							

TARGETS

The overarching aim of this strategy is to reduce the human impacts of heat across Western Sydney. The proposed targets focus on investment and collaboration, reducing local temperatures, increasing green infrastructure, quantifying and reducing economic impacts, and reducing health impacts. These targets are in a developmental stage and draw from existing literature, policy and strategies. The actions identified in this strategy are aligned to the five proposed targets, which provide a key point of focus for addressing urban heat in the Western Sydney context.

Further development of the targets will be undertaken by the working groups. Achieving these targets will need to be a collaborative effort with leadership at many levels.

1. Increase multi-sectoral collaboration and investment to deliver more projects to address the impacts of urban heat in Western Sydney by 2023. Establish a target for a number of projects to be delivered, diversity of sectors involved, and investment value by January 2019.
2. Reduce the average peak ambient temperatures in Western Sydney by 1.5°C through water, greening and cool materials strategies by 2023.
3. Zero net increase in economic impacts of heatwaves by 2023.
4. Zero net increase in morbidity and mortality impacts of heatwaves in Western Sydney by 2023.

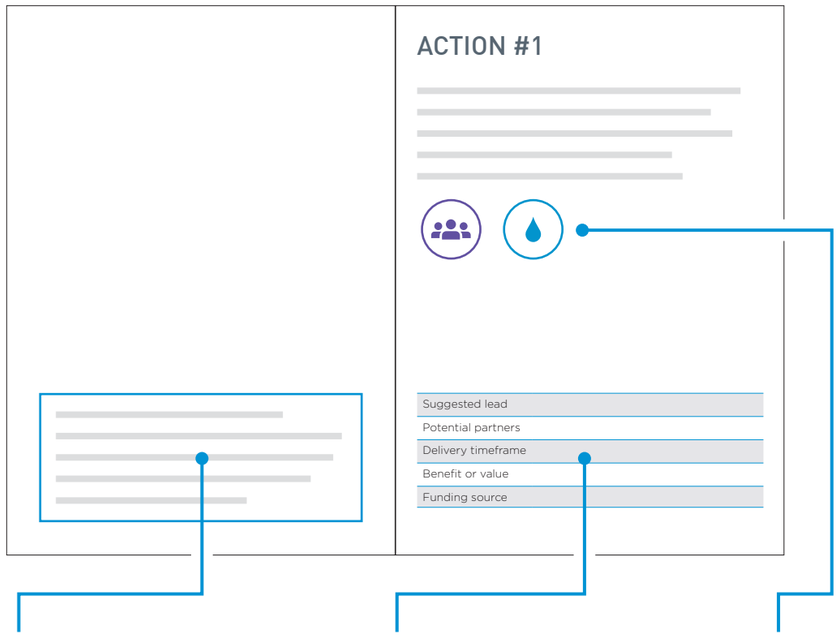
A monitoring and evaluation program will be developed to ensure that both targets and actions are evidence based and progress is measured.

HOW TARGETS WILL BE MET

TARGET	ALIGNMENT	STRATEGIC DRIVERS	APPLICABLE ACTIONS
Increase multi-sectoral collaboration and investment to deliver more projects to address the impacts of urban heat in Western Sydney by 2023. • **Establish a target for a number of projects to be delivered, diversity of sectors involved, and investment value by January 2019**	Alignment to Resilient Sydney strategy focus areas, OEH's Cross Dependency Initiative (XDI) and OEM's Management 2017 State Level Emergency Risk Assessment (SLERA) recommendations[27]	Take action, together	• Urban heat - state of the issue study • Urban heat research consortium • Monitoring and evaluation of proposed actions
		Innovative and responsive infrastructure	• Development of innovative funding models for cooling infrastructure
Reduce the average peak ambient temperatures in Western Sydney by 1.5°C through water, greening and cool materials strategies by 2023	Alignment to targets proposed in CRC LCL Cooling Potential, Impact of Urban Climate Mitigation Techniques in Western Sydney[3] and the Government Architect NSW's Greener Places policy.	Design and plan to cool the built environment	• Land use and design controls that prioritise resilience • Existing building retrofit programs • Social housing retrofit program
		Cool with green space and water	• Urban forest strategy • Green and blue infrastructure planning
Zero net increase in economic impacts of heatwaves by 2023	Alignment to Resilient Sydney strategy focus areas and OEM's 2017 State Level Emergency Risk Assessment (SLERA) recommendations[27]	Take action, together	• Urban heat - state of the issue study • Urban heat research consortium
		Innovative and responsive infrastructure	• Critical infrastructure provider forum on urban heat • Climate adaptive transport infrastructure and services • Development of innovative funding models for cooling infrastructure
Zero net increase in morbidity and mortality impacts of heatwaves in Western Sydney by 2023	Alignment to Resilient Sydney strategy[21] focus areas and OEM's 2017 State Level Emergency Risk Assessment (SLERA) recommendations, and Western Sydney Local Health District aspirations	Design and plan to cool the built environment	• Land use and design controls that prioritise resilience • Existing building retrofit programs • Social housing retrofit program
		Build a community that is healthy and prepared	• Preventative heat response framework • Urban heat community engagement strategy • Urban heat risk and impact research

HOW TO READ OUR ACTIONS

The actions described in the following section will be implemented across different scales and timeframes. Some actions are ready to be implemented right now, with the potential to deliver immediate benefits and some will require considerable advocacy before they are achieved.



Call out boxes highlight best practice examples that can help inform the implementation of the proposed action.

A table identifies potential leaders and partners for implementation of the action, delivery timeframe, benefits, and funding.

Icons indicate the action type(s). Actions may be assigned to multiple types in recognition of the complexity and overlapping nature of many of the strategic drivers.

Emergency response

Advocacy

Green infrastructure

Designing with water

Policy/ development controls

Research

Community engagement

Building retrofits

Health and amenity

TAKE ACTION, TOGETHER

The following actions relate to building stronger leadership and governance around the issue of urban heat, as well as organisational efforts to bring together knowledge and resources to better inform decision makers.

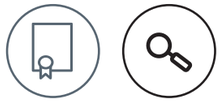
ACTION 1 URBAN HEAT - STATE OF THE ISSUE STUDY

A wide range of research activities and government efforts around urban heat in Western Sydney are completed and underway, but findings and lessons learned have not been clearly combined into a single document that can inform policy making. A broader scoping study commissioned in the next one to two years will outline the existing evidence base for various mitigation and adaptation measures. This will include measures of effectiveness of various mitigation techniques in reducing temperatures as well as costs compared to benefits, both in heat reduction and other benefits.

Benefits

Overall, this study will improve access to information and findings from existing and ongoing research in the issue of urban heat. This study will provide decision makers with access to relevant data sets about urban heat risks and impacts, including resolving any data inconsistencies. This information will benefit private sector and in government stakeholders, but it will also serve the Greater Sydney Commission in evaluating proposed plans around the metropolitan area.

Action type



Suggested lead	WSROC
Potential partners	NSW Office of Environment and Heritage, CRC for Low Carbon Living, Western Sydney University
Delivery timeframe	0-2 years
Benefit or value	Information to decision makers
Potential funding source	NSW Office of Environment and Heritage

State of the issue action details

A workshop participant shares his thoughts on urban heat

ACTION 2 URBAN HEAT RESEARCH CONSORTIUM

Establish an annual urban heat research summit that brings together a consortium of stakeholders to enable the inclusive discussion of critical gaps in research around the topic of urban heat. This will facilitate the opportunity for participants to form relationships across sector boundaries and research partnerships that leverage academic expertise and industry resources. The critical factor, however, is that this conference and perhaps an ensuing annual report must be inclusive of built environment decision makers. Today, the translation and communication of research work to industry and government can be lacking in some cases. This consortium can be aligned with the establishment of the Turn Down the Heat working groups and serve as an opportunity for all working groups to come together to provide updates on progress.

Benefits

Property developers and local government often complete their own individual cost benefit analyses for materials adjustments such as the use of white roofs in their development projects. These companies could save time and money if the evidence base for a given heat mitigation technique were clearly presented and suitable for presentation to leadership within their organisation. The savings have the potential to free up funding to partner with academics on new projects exploring innovative measures. A research summit will avoid duplication of research topics and inspire new collaborations that have a better distribution of funding costs and more targeted, readily applicable research.

Action type

Suggested lead	Academic community
Potential partners	Private sector and local government
Delivery timeframe	Near term 0-2 years
Benefit or value	Collaborative relationships
Potential funding source	Australian Research Council, potential various private sector sponsors, attendance fees

Research consortium action details

Which Plant Where

The *Which Plant Where* program is a five-year series of research projects that will explore where current species might be unlikely to thrive under the more extreme climates that Australian cities face, learn from past successes, and stress-test major landscape species to find opportunities for new species and varieties to be planted. Which Plant Where is funded through an innovative partnership between Western Sydney University, Horticulture Innovation Australia's 'Green Cities' fund, and the Office of Environment and Heritage.

For universities, it is not always easy to engage with stakeholders. It not that straightforward from a research and academic perspective to find the right connections in the private sector or government, but it is getting better and easier. I hope after this project, the concept of leveraging academic expertise for targeted research gains momentum, as people hear about it and see it, it [will be] easier to have similar ideas for new projects.

– Professor Ian Anderson, Chief Investigator, *Which Plant Where*, Western Sydney University

Research initiatives such as this provide valuable information to decision makers on how to best invest in their landscapes and open spaces. The research consortium will provide a forum to share such information with all relevant decision makers and with other researchers in the same subject area.

ACTION 3 MONITORING AND EVALUATION OF PROPOSED ACTIONS

Develop project specific monitoring and evaluation programs to ensure that existing and proposed actions are evidence based and success is measured, with support from the CRC Low Carbon Living. This monitoring and evaluation program will study both effectiveness of measures in their response to urban heat and their financial value as it compares to the cost of implementation. Ongoing monitoring and evaluation of heat mitigation techniques can allow resources to be put toward implementing actions that are supported by a strong evidence base.

Benefits

In an environment where resources to invest in resilience to urban heat are constrained, we must maximise the potential impact of every dollar of investment in urban cooling. Monitoring and evaluation will inform investment in new initiatives and will serve as justification for funding at a state and federal level. Finally, monitoring and evaluation will hold those implementing programs and projects accountable for the investment they have received.

Workshop participants discuss health concerns of urban heat

Ongoing partnership with the CRC LCL

The Cooperative Research Centres for Low Carbon Living (CRC LCL) is a national research and innovation hub that seeks to enable a globally competitive low carbon built environment sector and is supported by the CRC program. They have recently undertaken a strategic study entitled Cooling Potential and Impact of Urban Climate Mitigation Techniques in Western Sydney in partnership with Sydney Water and UNSW that is particularly applicable to providing an evidence base for the actions outlined in this strategy.

Action type

Suggested lead	CRC for Low Carbon Living
Potential partners	WSROC
Delivery timeframe	Near term 0-5+ years
Benefit or value	Information to decision makers
Potential funding source	CRC for Low Carbon Living has volunteered in-kind services for evaluation and monitoring

Monitoring and evaluation action details

URBAN HEAT MITIGATION TOOL KIT

Actions proposed under the *Design and plan to cool the built environment* and *Cool with green space and water* drivers aim to enable mitigation of urban heat through various projects, policies, and programs. Below, the physical interventions and evidence base that are behind these types of actions are explained in more detail.

Trees and green infrastructure

Trees and green infrastructure benefit the local microclimate through processes of shading, evapotranspiration, regulation of air movement and heat exchange. These benefits also greatly contribute to a decrease in ambient temperatures in the adjacent urban zones while helping to mask urban noise, filter urban pollutants, prevent erosion, stabilise the soil and also provide relaxation to visitors.

Despite myriad benefits, the full awareness or quantification of the holistic costs and benefits of green infrastructure at city scales is not well understood. The ownership of the costs and benefits is fragmented and therefore as a form of infrastructure, green infrastructure is not well protected, maintained or enhanced. Actions identified include measures to protect and increase green infrastructure.

Water

The mitigating potential of water-based techniques has been investigated by studying the temperature patterns in cities surrounded by lakes, rivers and other water reservoirs. It is a common conclusion that urban wetlands contribute to create 'Urban Cooling Islands' resulting in a significant decrease of the urban temperature. Apart from the natural water bodies in the cities, various technologies or techniques based on the evaporation of water, are used to design and integrate urban evaporative cooling systems able to decrease the ambient temperature. A variety of passive systems like pools, ponds and fountains are widely used in public spaces for decorative and climatic reasons, while active or hybrid water components like evaporative wind towers, sprinklers and water curtains have been developed, installed and tested in urban public spaces around the world.

Cool materials

Large-scale change of solar reflectance, or albedo, in local areas has a significant impact on the local peak ambient temperature. Increase of reflectance in a city will help prevent solar radiation from being absorbed. This can be achieved using materials of high diffuse solar reflectivity and high emissivity value, known as cool materials. The specific materials should be applied mainly in roofs, pavements and all other horizontal surfaces in the city.

The above mitigation techniques were explored in Sydney Water and the CRC Low Carbon Living's recent Cooling Western Sydney report, which found that appropriate heat mitigation strategies can be very effective in lowering ambient temperatures and reducing the negative effects of urban overheating. Higher reductions have been achieved by the scenario of water-based technologies combined with cool materials. More specifically, it was found that the large scale application of cool materials and water-based technologies could result in an average air temperature reduction of 1.5 °C in the area, with local reductions close to the water reaching 10 °C.

Western Sydney waterway

DESIGN AND PLAN TO COOL THE BUILT ENVIRONMENT

Western Sydney is growing at an unprecedented rate. This growth represents an opportunity to create a more thriving, liveable community, but also a risk that if growth is poorly managed, it could have negative heat impacts on current and future residents. Managing the impact of Western Sydney's growth on the built environment through existing regulatory channels can make resilience to urban heat a part of the very fabric of Western Sydney. A resilient built environment is not just related to sustainable new development. Enabling and engaging private property owners to retrofit their existing properties is equally important for reducing the number of dark coloured roofs and enhancing the performance of buildings to reduce demand on the energy grid.

Over 11% or 734 km^2 of the Sydney Greater Metropolitan Area (GMA) is projected to change land-use types between 2006 and 2036 based on the urban density categories studied. Large areas of the GMA to the south-west and north-west are projected to have temperature increases of 1–1.4°C due to these land-use changes[28]. Managing the way that the built environment, both existing and new development, contributes to urban heat will be imperative to making any substantial progress in lowering temperatures in Western Sydney.

Shade structures keep a playground cool

ACTION 4 LAND USE AND DESIGN CONTROLS THAT PRIORITISE RESILIENCE

Appropriate changes to building codes, land use and design controls that prioritise green space and green infrastructure will help change the way that buildings and communities are constructed and designed. Land use and building design controls must be adjusted at several different scales in order to maximise effectiveness and ensure that density and form of new development is appropriate for future climate conditions. Promotion of water sensitive urban design (WSUD) will also be an important part of land use controls. For those not in a position to impact change in these land use and design controls, advocacy will be the primary role. This strategy recommends the following adjustments to existing development controls:

1. **Develop a heat related State Environmental Planning Policy**
   A Western Sydney heat-related State Environmental Planning Policy (SEPP) would acknowledge the issue of urban heat as a matter of regional environmental planning significance. A strategic policy position of this type has the potential to change development on several tiers; it can guide aspects of local level development plans (including complying developments) as well as Building Sustainability Index (BASIX) controls for dwelling design. A state level policy brings resources and enforcement capacity stronger than what any individual local government might be able to achieve.

   The development of a new SEPP can be undertaken in coordination with the update of the BASIX standards to include consideration of urban heat for improved residential development.

   This action proposes to better collaborate and develop a consistent advocacy position to work with the NSW Department of Planning and Environment to update BASIX standards to ensure that requirements of new buildings suitably address urban heat. BASIX standards currently include a provision for light coloured roofs, but could be strengthened and expanded further to include landscape rules and regulations tailored to lot size or housing type. The outcome of this action will be more buildings that are resilient and responsive to the issues associated with urban heat, in addition to being more energy efficient.

2. **Add consistent clauses outlining urban heat standards to local Development Control Plans (DCP) and Local Environment Plans (LEP)**
   At the local level, the addition of clauses outlining urban heat standards to Local Environmental Plans (LEPs) and Development Control Plans (DCPs) will help apply best practices in development to local projects. Councils should coordinate to develop and adopt new clauses into the Development Control Plans specifying targets for green cover, building materials, water sensitive urban design and other measures mitigating urban heat. These targets will respond to specific location and built environment typology.

   Lack of resources for enforcement has been identified as a potential challenge in successful outcomes for new LEP and DCP clauses. The Turn Down the Heat's Built Environment working group will serve as a forum for knowledge sharing and debate regarding updating local development controls and will allow for the regulations to have more diverse input from outside of government.

City of Parramatta Development Control Plan

New urban heat Development Control Plan (DCP) clauses are being developed by the City of Parramatta Council for the Parramatta CBD. They will also be accompanied by an Urban Heat Design Guide to support implementation of the controls. Clauses are set to be released with the impending public exhibition of the Draft Parramatta CBD Local Environment Plan (LEP) in 2018 and will be approved and adopted as part of that review process. If successfully adopted, the clauses will serve as a useful model to be adopted by other councils and have the potential to create consistency in development controls regarding heat across the region.

ACTION 4 LAND USE AND DESIGN CONTROLS THAT PRIORITISE RESILIENCE (CONTINUED)

3. **A systematic change to building codes and specifications to promote development that addresses and minimises urban heat island effects**
   At the federal level, building design regulation can ensure a certain level of energy efficiency through insulation, building materials, and roof solar reflectance ratings. Broadly, federal regulations for building codes can save administrative time at the state and local level for enforcing requirements such as material performance specifications and create change on a larger, more efficient scale.

Benefits

Because of the significant proposed growth in Western Sydney, land use and building design regulations have far-reaching potential to cool the region. Areas where buildings reflect more heat from the sun instead of absorbing will feel cooler and more comfortable on hot days. Controls for density and urban form will ensure that cooling breezes are maximised and heat minimised.

Action type

Suggested lead	SEPP - NSW Department of Planning and Environment BASIX - NSW Department of Planning and Environment DCP and LEP – local government Building Code – Australian Building Code Board, Department of Industry
Potential partners	Local government, Resilient Sydney
Delivery timeframe	0-2 years
Benefit or value	Mitigation of urban heat through use of cool materials, mitigation of urban heat through regulation of density and form, mitigation of urban heat through more strict green space requirements for development
Potential funding source	To be supported within operational budgets (staff time) of each regulating body

Land use and design controls action details

Aerial view of a Western Sydney street

ACTION 5 EXISTING BUILDING RETROFIT PROGRAMS

While sustainable new development is very important to the future of Western Sydney, so is the retrofit of existing buildings to reduce urban heat island and improve comfort and energy efficiency within each building. Key retrofits to be included in the program are cool roofs and improved home insulation to keep cool air in and hot air out.

This action comprises two components, the education of property owners on the benefits of retrofitting their properties and program support for doing so. The program should be promoted to existing outreach platforms that have high viewership to generate strong program participation. Some educational resources of this type exist from the NSW Department of Planning and Environment, but could be more widely circulated and the benefits (20-40% reduction in heating and cooling costs) could be more readily compared to the potential costs. A potential barrier to implementation of this action is councils or communities with specific design guidelines specifying dark roof colours. These restrictions must be lifted in order to effectively implement a program for building retrofits to create cool roofs.

Given the average roof life cycle of 20-50 years, with the right programs and policies in place, there is no reason Western Sydney shouldn't have close to 100% cool roofs within three to four decades.

Benefits

Cool roofs reflect heat from the sun and reduce the amount of heat held in the urban environment surrounding the building. Furthermore, they improve energy efficiency of their particular building. Enhanced insulation in buildings throughout Western Sydney will improve energy efficiency of the building as well as enhancing indoor comfort.

Program outreach will serve as community engagement and will raise awareness about the potential benefits homeowners and building operators can realise if they adapt their structures to use cool materials.

Action type

Suggested lead	NSW Department of Planning and Environment (DPE)
Potential partners	Local government
Delivery timeframe	0-2 years
Benefit or value	Enhanced indoor comfort, reduced energy usage, mitigation of urban heat through increased solar reflection
Potential funding source	OEH NSW Draft Climate Change Fund Strategic Plan

Retrofits program action details

ACTION 6 COOL SOCIAL HOUSING PROGRAM

Collaborate with social housing providers to work toward appropriate cooling measures for social housing such as installing high efficiency air-conditioning for residents over a certain age, or who have increased levels of vulnerability due to pre-existing medical conditions. Supporting programs in which volunteers check on vulnerable residents during a heat event will also be critical. Outside the home, accessible cool refuges (shaded outdoor spaces and cooled indoor spaces) can provide respite for people who are disproportionately impacted by extreme heat can save lives and prevent other health risks.

Benefits

The reduction of health impacts among socially vulnerable populations is the primary benefit of this program. Where solar panels are included in the installation of air conditioning, a net reduction in emissions could be possible as well. Furthermore, communal areas of respite have the potential to improve social cohesion within the social housing development.

Action type

Suggested lead	Office of Environment and Heritage
Potential partners	Aboriginal Housing Office, community housing providers, local government, Family and Community Services, community nurses via the local area health service, Office of Social Impact Investment
Delivery timeframe	3-5+ years
Benefit or value	Preparation for urban heat, social benefits
Potential funding source	Energy companies, Climate Change Energy Affordability Package

Retrofits program action details

Home energy action program

In 2013, the $2.6M Home Energy Action (HEA) program for upgrades to social housing was created. In 2017, The Office Environment and Heritage (OEH) renewed the program and expanded funding.

Home Energy Action Program replaces appliances such as fridges and televisions with more energy efficient models to reduce bill stress. The Office Environment and Heritage has also engaged with the Community Housing Sector and offer a 50% match of funding for building upgrades such as

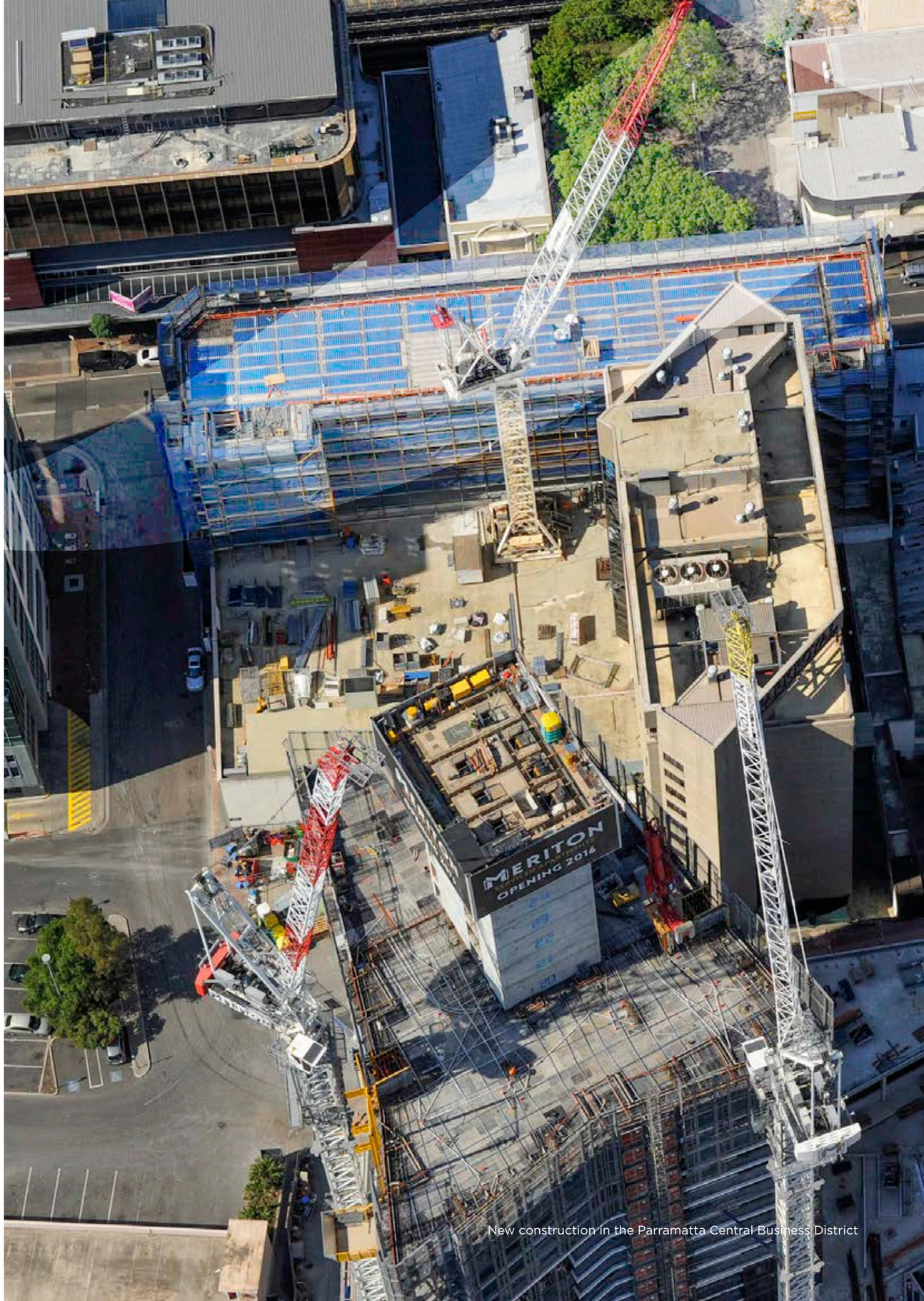
- Ceiling insulation
- LED lights
- Solar panels
- Installation of split system air conditioning
- Installation of heat pump

Expansion of programs like the above will advance the goal of social housing that reduces risk among the vulnerable during heatwaves.

Aboriginal Housing Office

In 2016, the Aboriginal Housing Office (AHO) developed a policy in which they commit to the installation of air conditioning for properties where the air temperature exceeded 33°C on the majority of days each year.

Where possible, the AHO is also installing solar panels at the same time as the energy efficiency air conditioning to reduce cost of increased energy use for vulnerable populations.



New construction in the Parramatta Central Business District

COOL WITH GREEN SPACE AND WATER

The *Cool with green space and water* strategic driver includes priority actions that have some of the widest reaching benefits in this strategy. The benefits of green space include recreational use, biodiversity, improved social and health outcomes, absorption of stormwater, shade, air quality, reduction of urban heat, and more. These many layered benefits are why trees and green space receive so much focus as part of the discussion of urban heat. Trees and green infrastructure mitigate urban heat and provide areas of cooling and respite, enhancing walkability, but also have myriad other benefits to help justify the investment. Green our urban areas contains actions around green infrastructure, the urban forest, policy considerations of green space, and the Blue and Green Grids. Implementation of broad initiatives around urban greening can start today, with planning and construction to be ongoing. As part of early planning efforts in these thematic areas, clear, measurable targets should be set for project outcomes.

A shady Blue Mountains street in Autumn

ACTION 7 ADOPTION OF SYDNEY'S BLUE AND GREEN GRIDS

The Greater Sydney Commission released District Plans in March 2018 as a guide for implementing the Greater Sydney Regional Plan and a bridge between regional and local planning. The Greater Sydney Green Grid, created in conjunction with the Government Architect NSW, is featured in the District Plans and promotes the creation of a network of high quality open spaces that supports recreation, biodiversity and waterway health. The Green Grid will create a network that connects strategic, district and local centres, public transport hubs, and residential areas. The Blue Grid, the network of Sydney's waterways, is closely related to the Green Grid concept because all the proposed green spaces and green infrastructure projects will require water, demand for which is already going to be strained by population growth. The projected future increase in periods of drought will strain the water supply even more. There is a major opportunity for recycled water and stored rainwater to irrigate the green grid instead of being treated and pumped into rivers or piped to the coast.

Benefits

Open space is one of Sydney's greatest assets. Our national parks, harbour, beaches, coastal walks, waterfront promenades, rivers, playgrounds and reserves are integral to the character and life of the city. Resilience benefits will be derived both from the enhancement of and connections between blue and green spaces.

Implementation of the Blue-Green Grid will happen through the combination of many future planning efforts and projects across the regional area, with the Greater Sydney Commission checking for alignment with the District Plans and with the Blue and Green Grid concepts outlined therein.

Action type

Suggested lead	Office of Industry, WaterNSW
Potential partners	Greater Sydney Commission, Sydney Water
Delivery timeframe	3-10+ years
Benefit or value	Mitigation of urban heat, social benefits, environmental benefits
Potential funding source	Potential funding could come from the NSW Government and WaterNSW

Implement the Blue and Green Grids action details

ACTION 8 URBAN FOREST STRATEGY

The NSW Government has made a landmark $230 million funding commitment to plant five million trees across Sydney.[29] However, planting the right trees in the right place with the right maintenance plan is essential to maximising the benefits of this significant investment. Management of Western Sydney's urban forest requires a clear strategy for keeping trees healthy in stress (drought) conditions and for identifying and supplementing areas that lack adequate tree canopy.

Western Sydney's urban forest management could be supported by a detailed tree inventory. Research funding could be leveraged to undertake the significant investment of a comprehensive tree inventory for urban areas in Western Sydney. An urban forest strategy will bring city-wide benefits that cannot be achieved by individual councils, suburbs, infrastructure operators, or neighbourhoods in isolation.

Benefits

A greener Western Sydney means shadier, cooler public areas, lower flood risk, and less runoff entering waterways. Trees have been shown to increase property values in neighbourhoods and to increase energy efficiency of homes.[30] Greener cities also have lower levels of obesity, higher levels of physical activity, and improved mental health. As well as broader societal benefits, trees and green infrastructure have very important direct transport benefits in terms of soil erosion, weed control, graffiti deterrence, wayfinding, visual cues and headlight glare avoidance.

Challenges

Some potential challenges to be addressed in the urban forest strategy are ensuring that appropriate climate resilient species are planted around Western Sydney. Various grant programs that include funding for planting of trees should be reviewed; many include species requirements for native plantings that may not be appropriate where greater shade amenity is needed or for site conditions.

In some communities in Western Sydney, the value of street trees is not well understood. Residents fear falling branches and dislike the idea of leaf clean-up. Communication of the many benefits that trees can provide must be part of the community engagement for the urban forest strategy. The Cool Streets Blacktown project, a partnership between Blacktown City Council and Gallagher Studio's Cool Streets™ initiative, is an outstanding example of inclusive design and planning. The program engages residents in design and selection of trees for their street and has been successful in reducing the misconceptions around trees.

Another critical step is to address the disconnect between the responsibilities of transport and energy authorities and the priorities of city planners and the community. For example, transport authorities remove some trees to protect road and rail users and avoid liability for damage to properties. Energy companies trim trees to ensure they don't damage the energy network or other assets. They might understand why green infrastructure is important, and some are adjusting their operating guidelines to reflect this, but making Australian cities greener is not their chief task. Balancing these priorities is important, not only to realise the financial benefits of trees, but so these organisations can avoid potential reputational damage resulting from excessive tree pruning. Resolving this requires changes to the regulations and guidelines these organisations follow. Broader public engagement between city stakeholders and the community can also help all parties understand where the benefits of trees outweigh the safety risks. Ideally, more parties will share the liability, as well as the costs and benefits associated with street trees.

A shady Western Sydney streetscape

City of Canterbury Bankstown Biodiversity Strategic Plan 2015 - 2025

City of Canterbury Bankstown has implemented a Biodiversity Strategic Plan which outlines the Urban Heat Island effect, and strategies that ameliorate its effects. An example of this was setting a target to increase urban canopy cover by 30% by 2025. The City has now also launched its urban forest fund to accelerate greening across the city.

Resilient Melbourne Urban Forest Strategy

The Melbourne Urban Forest Strategy serves as a useful example for process and delivery of an urban forest strategy in Western Sydney. Melbourne's strategy seeks to manage significant challenges of climate change, population growth and urban heating and protect against future vulnerability by providing a robust strategic framework for the evolution and longevity of Melbourne's urban forest. The strategy aims to adapt Melbourne city to climate change, mitigate the urban heat island effect by bringing inner-city temperatures down, create healthier ecosystems, become a water-sensitive city, and engage and involve the community.

The strategy sets clear targets for an increase in canopy cover from 22% to 40% by 2040, increasing forest diversity with no more than 5% of one tree species, no more than 10% of one genus and no more than 20% of any one family, improving vegetation health, improving soil moisture, improving biodiversity, informing and consulting with the community.

Action type

Suggested lead	WSROC
Potential partners	Greater Sydney Commission, local government, NSW Government Architects Office
Delivery timeframe	0-2 years
Benefit or value	Mitigation of urban heat, environmental benefits
Potential funding source	OEH Draft Climate Fund

Urban forest strategy action details

ACTION 9 RECOGNITION OF TREES AND GREEN INFRASTRUCTURE AS CRITICAL URBAN INFRASTRUCTURE

The age of much of Western Sydney's hard infrastructure will be a factor in council budgets for many years to come as kerbs, streets, gutters, all need repair and replacement based on their age. Construction and maintenance of green infrastructure and the urban tree canopy needs to hold the same priority for investment and maintenance as hard infrastructure, which will maintain the cooling capacity of the green infrastructure asset. A healthy network of green infrastructure solutions and tree canopy will reduce urban heat island effect and improve liveability.

A commitment signed by local government as part of the adoption of the Turn Down the Heat Strategy could signal a new commitment to investment in creation and maintenance of green infrastructure, despite competing funding priorities. Advocacy around a commitment to preserving trees could be spearheaded within the *Cool with green space and water* local council working group.

Benefits

Formal recognition of trees and green infrastructure as critical urban infrastructure will help preserve investment in increasing green cover even in an ever more resource constrained environment. Adequate investment in trees and green infrastructure today and in the near term will reap amenity and cooling benefits for generations to come.

Action type

Suggested lead	WSROC
Potential partners	Local government
Delivery timeframe	0-2 years
Benefit or value	Organisational adaptive capacity, mitigation of urban heat by maintaining trees
Potential funding source	OEH Draft Climate Change Fund

Green infrastructure as critical infrastructure action details

A bioswale green infrastructure project in a road median

Cool Streets Blacktown

Meaningful expansion of green infrastructure will be achieved through a multifaceted approach. Engaging the community to understand the value of green infrastructure will be a major part of building public support for planting of trees across the region. The Cool Streets Blacktown project, a partnership between Blacktown City Council and Gallagher Studio's Cool Streets™ initiative, was successful in engaging residents in supporting and selecting street trees for their street and in overcoming stigma around street trees in local neighbourhoods. It is an engagement program model that will continue to expand as funding becomes available.

Residents and Mayor of Blacktown City Council, water a newly planted tree in Blacktown

ACTION 10 BLUE AND GREEN INFRASTRUCTURE PLANNING

Increase and expand blue-green infrastructure on public land, in particular by developing sustainable funding sources and maintenance programs. Blue-green infrastructure encompasses a range of interventions, including porous pavement; bio-swales; rain gardens; tree planters; green streets, alleys, and parking lots; green roofs; and constructed wetlands. Valuable blue-green infrastructure, especially in urban areas, can also include green walls and green roofs on public buildings. Councils should secure commitments from partners to create a certain amount of blue-green infrastructure and to publish and share blue-green infrastructure best practices.

Benefits

In addition to absorbing stormwater and reducing urban runoff, blue-green infrastructure can help mitigate the urban heat island effect by creating shade, reducing heat-absorbing materials, and emitting water vapour that cools the air, an occurrence known as evapotranspiration. It also can help create an attractive environment, clean the air by filtering airborne pollutants, and reduce building energy costs through shading and recyclable water.

Challenges

Funding for construction and maintenance are two common challenges for successful implementation of blue-green infrastructure planning efforts. Some organisations hire specialist maintenance crews that tend specifically to blue-green infrastructure. Others host training across all parks and grounds maintenance crews to ensure that blue-green infrastructure investments and benefits are maintained. However, the additional labour of maintaining blue-green infrastructure systems is not without cost. Planning efforts should explore creative solutions for long term maintenance funding of blue-green infrastructure projects.

Urban Green Cover in NSW Technical Guidelines

The Office of Environment and Heritage's (OEH) Urban Green Cover in NSW Technical Guidelines (2015) are also part of the NSW Government's intent to minimise and accommodate the impacts of climate change to communities, health services and local infrastructure. The Guidelines recognise the need for urban environments to withstand projected increase in extreme heatwaves, intense storms and localised flooding. OEH includes a range of urban green cover strategies such as vegetated and reflective roofs, green walls, street plantings, permeable and reflective road surfaces, and open spaces and parks. These combined approaches to cool urban environments will also provide ecosystem services such as stormwater management, clean air, and habitats in addition to reduced energy costs for cooling. The guidelines are meant for integration in strategic plans, development control plans, public domain guidelines and/or urban design studies.

Action type

Suggested lead	Local government
Potential partners	State agencies, Sydney Water
Delivery timeframe	0 -10+ years
Benefit or value	Mitigation of urban heat, environmental benefits
Potential funding source	Blended funding from LGAs

Blue-green infrastructure action details

GREENER PLACES

Greener Places is a draft green infrastructure policy produced by the Government Architect NSW in conjunction with the Department of Planning and Environment and the Greater Sydney Commission to guide the planning, design and delivery of green infrastructure in urban areas across NSW. It aims to create a healthier, more liveable and sustainable urban environment by improving community access to recreation and exercise, supporting walking and cycling connections, and improving the resilience of urban areas.

The documents supporting the draft policy include the following draft manuals/toolkits:

- Open space for recreation
- Bushland and waterways
- Urban tree canopy

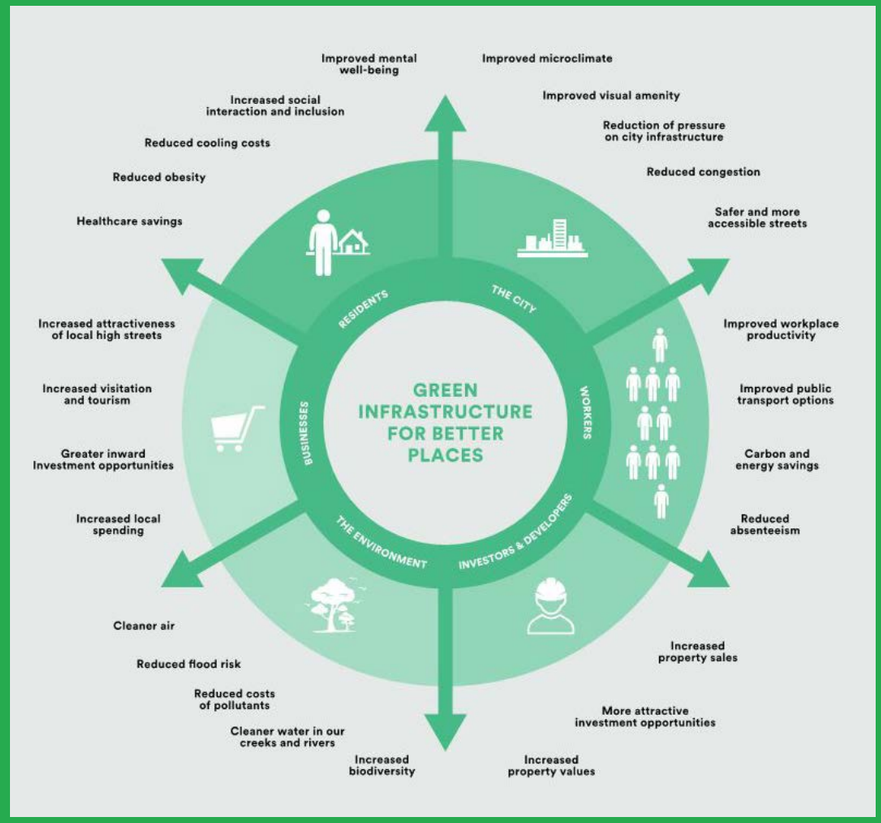
Greener Places builds on the Sydney Green Grid - the design-led Green Infrastructure strategy developed to create a network of high quality green areas that connect town centres, public transport networks and major residential areas in Sydney. Greener Places is a state policy which is assessed against agreed criteria, enabling better opportunities for industry to embed the benefits of a greener approach to projects. This in turn will create better places and landscapes.

Greener Places advocates for early integration and collaboration between design, planning, funding and governance. It fosters long-term, coordinated decision-making in planning problems and processes.

It sets out principles and measurable outcomes intended to be adopted by industry and government agencies, as well as by communities who inhabit the places and spaces of NSW. The principles in this document can help guide the determination of planning applications.

1. Integration: combine green infrastructure with urban development and grey infrastructure
2. Connectivity: create an interconnected network of open spaces
3. Multi-functionality: deliver multiple ecosystem services simultaneously
4. Participation: involve stakeholders in development and implementation

Greener Places seeks to use the green infrastructure components that lie within our city environments and perform essential ecosystem services to create a network of healthy and attractive new and upgraded city environments, sustainable routes and spaces that build on and strengthen existing green infrastructure components.



Who benefits from green infrastructure? (Government Architect NSW)

BUILD A COMMUNITY THAT IS HEALTHY AND PREPARED

The ultimate outcome for all the actions in this strategy is better health and wellbeing for the people of Greater Western Sydney. The actions outlined in this section of the implementation plan relate to the creation of a preventative response framework to keep people safe and healthy in a heatwave, strong research on at risk populations, and engagement with communities to spread awareness about the risks of urban heat and ways to keep cool.

The Western Sydney, Nepean Blue Mountains, and South West Sydney Local Health Districts deliver health care to more than a million people living in the state's fastest growing region. The health districts lead the charge in local level health adaptation to extreme heat and collaborate across districts to share policy and best practices for heat response and preparation. For example, in partnership with City of Parramatta Council, Western Sydney Local Health District (WSLHD) have held 'Beat the Heat' educational sessions for member of the community advising them on ways to stay cool during heatwaves and how to manage heat-related illnesses. All the actions outlined in the following section should be aligned with existing adaptation frameworks where possible.

Sydney's Chief Resilience Officer, Beck Dawson, presents on the impacts of urban heat at the November 2017 Turn Down the Heat Actions Forum

ACTION 11 PREVENTATIVE HEAT RESPONSE FRAMEWORK THAT FOCUSSES ON PROTECTING THE VULNERABLE AND CONNECTING COMMUNITIES

A coordinated response, applied before and during a heatwave, is required to minimise human health risks and risk of disruption to business. Such a response framework will involve emergency management procedure and preparation, but also outreach to the community service providers that interact with vulnerable populations on the most frequent basis. The very young and the very old, as well as those with pre-existing medical conditions, are especially at risk in a heatwave. Many elderly people also have higher rates of social isolation, meaning that they may not have anyone to check on them or help them keep cool during a heatwave. Communities that have high levels of urban stress generally have a weaker understanding of the risks that heatwaves pose; their existing vulnerability compounds with the risk of an individual shock event.

Components of a people-centred heat response framework:

1. **An updated heatwave sub plan**
   The aim of the 2011 NSW State Heatwave sub plan is to detail the arrangements for the control and coordination of, the preparation for, response to, and immediate recovery from heatwave events within NSW to reduce the risk or counter the effects on the community. The plan needs to be validated based on effectiveness in heatwaves in the last six years and updated to reflect lessons learned and evolving digital tools for emergency outreach. Furthermore, an updated sub plan must be launched with appropriate engagement at the local government level so that their role in heatwave emergency response is better understood.
2. **Build heat response capacity within community service provider organisations**
   Community service providers such as the Department of Family and Community Services provide essential support to vulnerable populations in Western Sydney. However, the efforts of various supporting organisations are siloed. A coordinated approach across service providers is essential. On the ground staff, already in a position of trust, must have the knowledge and capacity to effectively engage with clients on the risks of heat and to help clients understand their options for personal cooling strategies. Additionally, NSW Health and corresponding Local Health Districts should leverage their existing relationships and communication with nursing homes providers (including an annual meeting) to discuss the risks of urban heat, including need for backup power supply and increased risk of foodborne diseases.

Benefits

The key benefit to a stronger response framework will be a reduction in the health impacts of heatwaves, including a reduction in the mortality and morbidity rates. Collaboration across organisations in responding to heatwaves will generate efficiencies and reduce the number of vulnerable people falling through the cracks.

Action type

Suggested lead	Western Sydney Local Health District
Potential partners	NSW Health, local government, Family and Community Services, Australian Centre for Social Innovation (TACSI), Office of Emergency Management, other local health districts
Delivery timeframe	0-2 years
Benefit or value	Organisational adaptive capacity, social benefits, collaborative relationships
Potential funding source	Australian Centre for Social Innovation Grant, NSW Health

NSW Office of Emergency Management's 2017 State Level Emergency Risk Assessment (SLERA)

In 2017, the NSW Office of Emergency Management (OEM) undertook an emergency risk assessment for New South Wales, collaborating across the emergency management sector to assess natural and human-induced hazards facing the NSW community. Priority hazards identified included heatwaves, which were rated as an extreme risk. There is opportunity to work with the State Emergency Management Committee as they implement their recommendations over the next five years. There is strong alignment between WSROC's Turn Down the Heat drivers and actions, including enhancing land use planning, improving data and risk modelling, adapting to climate change impacts, increasing coordinated community engagement, and making public warnings consistent. The OEM has been involved in the development of WSROC's Turn Down the Heat Strategy and will be a key partner during implementation.

Preventative response framework action details

ACTION 12 URBAN HEAT COMMUNITY ENGAGEMENT STRATEGY

A regional community engagement strategy will raise awareness around the dangers of extreme heat. The NSW Health Beat The Heat program and Cool Parramatta engagement strategy can be used as models for the strategy. Current heatwaves will be used as opportunities to call attention to heatwaves as a risk and to educate and change public attitudes. Local community groups and council planners should team with educational outlets (schools) and the media to disseminate information across a wide variety of outlets.

An engagement strategy informed by local community leaders who know their citizens best will be most effective in sharing information, informing decision making, and helping create better prepared communities. This strategy delivered at a regional level will generate efficiencies over each individual council creating its own outreach program.

Benefits

Engaging the community will build adaptive capacity within the social fabric of Western Sydney. It will remind residents and employees to take care to reduce the risks to their own health by finding areas of respite and also has potential to enhance social cohesion and increase the rate of residents checking on their neighbours in a heatwave. When people know how to reduce their own health risks, it also reduces the number of emergency room visits and hospitalisations, avoiding stress on the Western Sydney medical system. Community engagement as part of a planning process is important in all cases, but as it relates to urban heat, it has the potential to be life saving for members of the Western Sydney community.

Western Sydney residents participate in a planting day

Action type

Suggested lead	Western Sydney Local Health District
Potential partners	Nepean Blue Mountains Local Health District, South West Sydney Local Health District, NSW Health, NSW Multicultural Health, University of Sydney, Office of Emergency Management, City of Parramatta Council
Delivery timeframe	3-5 years, aligns to OEM risk assessment recommendations
Benefit or value	Personal adaptive capacity, social cohesion
Potential funding source	Seed funding opportunity through in place Australia Research Council (ARC) Grant application, NSW Health

Community engagement strategy action details

How the locals beat the heat

In 2016, WSU's Institute for Culture and Society produced a Pilot Research Report titled 'Cooling the Commons', the study sought to explore insights into how residents living in Western Sydney keep cool during the hottest parts of the year and how they would like to see their communities improved to address wellbeing in the face of increasing extreme heat events. The study presented a range of innovative and practical methods that people in Western Sydney are already employing to help beat the heat. Examples ranged from spending more time in shopping malls, cafes and air-conditioned spaces (for example the play areas within McDonalds) to enjoying green spaces. One of the three groups interviewed as part of the research comprised a selection of senior citizens from Penrith. This group provided some interesting insights on the variety of cooling strategies they adopted around the home and for conserving their energy use during the hot weather.

"Participants discussed wetting and hanging, or draping material, or freezing water in cake tins and blowing cold air over them as cooling strategies." Those with air-conditioning also discussed the self-imposed rules they had introduced around when it could be used, "I have rules...it has to be at least 30°C – usually my body can tell me. The other day it was 34°C before I turned it on...as soon as it starts to cool down, we turn it off" (WSU, 2016, p. 15 – 16).

ACTION 13 RISK AND IMPACT RESEARCH

Undertake appropriate research projects to better quantify community and social impacts of urban heat. For example, gaining an empirical understanding of behaviours and locations of vulnerable populations during an urban heat event could help prepare appropriate resources and efforts for future heatwaves. This research could inform better decision making and provide an evidence base to justify investment in action. A better understanding of adaptive behaviours and adaptive capacity within a given at-risk community can help local health district officials better manage the impacts of heat and prevent the health episodes that disrupt everyday activities.

Local health risk assessments study at risk populations and risk thresholds should be supported by an open data set of health and mortality factors. Rigorous research, distilled into a publically accessible form, can help inform decision makers and the general public in creating and prioritising resilience strategies. These research projects should be encouraged to make policy recommendations to government stakeholders where it is clearly supported.

Benefits

Urban heat risk research can lead to more informed decision making across many sectors, for example:

- Health research can help decision makers and health care providers understand which populations are at highest risk and allocated resources in the highest need communities, It can also help evaluate cooling techniques and ability to reduce health impacts during a heatwave
- Urban planning research such as the CRC Low Carbon Living Urban Heat Island Decision Support Tool can help local planners understand the microclimatic effects of new buildings and the urban form how Western Sydney grows
- Environmental research that studies which plant species are at risk in changing future climates and which are resilient can inform landscape and green infrastructure management.

Action type

Suggested lead	Western Sydney Local Health District
Potential partners	University of Sydney, Office of Emergency Management, NSW Health, other local health districts
Delivery timeframe	3-5 years, aligns to OEM risk assessment recommendations
Benefit or value	Information sharing, organisational capacity
Potential funding source	Seed funding in place Australia Research Council (ARC) Grant application

Risk research action details

Human Health and Social Impacts Node

The Office of Environment and Heritage's (OEH) Human Health and Social Impacts Node, established 2017, is undertaking various research projects on the health impacts of climate change. Heat is one of the most important climate hazards in terms of health impacts. A description of one of their research projects related to heat can be found below.

Climate Change: Housing, and health: a scoping study on intersections between vulnerability, housing tenure, and adaptation responses to extreme heat

This research project explores the extent to which unaffordable, insecure, or marginal forms of housing exacerbate existing climate related vulnerability.

- Lab testing of heat stress experienced by residents of different housing scenarios
- Lab testing of low cost cooling technologies applicable in these housing scenarios

Heatwaves and the older Australia population

University of Sydney, School of Public Health, Leigh Ann Wilson

This research investigated the relationship between heat-related mortality and morbidity in NSW and the factors that place older people at risk of heat-related illness. Less than half of the aged care facilities (ACFs) included in the research sample had a heatwave response plan. Only one third of ACFs in NSW were fully air-conditioned, 65% had partial or no air-conditioning. Few ACF staff had participated in staff in-service training on caring for older people in extreme conditions. Older rural residents with a self-perceived sense of 'wellness' do not consider themselves at risk in hot weather, even if they have multiple illnesses, or are aged; factors that independently place them at increased risk of heat-related morbidity and mortality.

This research found that high daily temperatures have both direct and indirect effects on the health of the adult population. There was a general complacency about, and low perception of, heat-related health risk in the Australian population and a low level of preparedness for extreme heat events in the aged care sector, both in the knowledge of how to care for the vulnerable aged in very hot weather and in organisational planning for periods of extreme heat.

Stephen Corbett, Director of the Centre for Population Health in the Western Sydney Local Health District, presents research findings on the health impacts of heat

INNOVATIVE AND RESPONSIVE INFRASTRUCTURE

Critical infrastructure providers' core mission does not focus on urban heat, so issues of green infrastructure and the role it plays to combat urban heat can sometimes be deprioritised. This section of the strategy focuses on how providers can work with one another and with local government to ensure disruption is prevented or minimised in an extreme event and how funding and regulatory structures can be adjusted so that green infrastructure and other important initiatives do not get sidelined.

While the importance of reliable and responsive infrastructure is without question, the actions around infrastructure in this strategy pertain to the sphere of control of the stakeholders who have engaged in the planning process to date and represent only the beginning of the conversation on infrastructure and urban heat. The project team has engaged with water and energy providers, however Transport for NSW is yet to engage with the process.

A shaded Western Sydney street

ACTION 14 - CRITICAL INFRASTRUCTURE PROVIDER FORUM ON URBAN HEAT

The Australian Government's Critical Infrastructure Resilience Strategy which comprises a policy statement and a plan for practical implementation, aims to ensure the continued operation of critical infrastructure in the face of all hazards. The NSW Office of Emergency Management's State Level Risk Assessment (2017) identifies critical infrastructure services as a major focus for planning efforts going forward. Resilient infrastructure supports the continued provision of essential services to businesses, governments and the community, as well as to other infrastructure sectors. Secure and resilient infrastructure supports productivity, and helps to drive the business activity that underpins economic growth.

It is crucial that utilities and essential services providers in Western Sydney each have a clear understanding of their role in continuity of services and their interdependencies. For example, water services are also major power users. Disruption of the power supply in a heatwave could have flow on impacts on citizen water supply, further worsening negative health impacts of a heatwave and lack of air conditioning availability.

Benefits

Improved communication between infrastructure providers can help ensure continuity of essential services in a heatwave when power and water supplies are at their most stressed. Continuity of the power supply can prevent spikes in the mortality rate usually associated with any prolonged power outage.

Action type

Suggested lead	NSW Department of Planning and Environment, NSW Department of Industry
Potential partners	Sydney Water, Endeavour Energy, Ausgrid, Commonwealth Attorney General's Department, WSROC, Greater Sydney Commission, Resilient Sydney
Delivery timeframe	0-2 years
Benefit or value	Collaborative relationships, information to decision makers, organisational adaptive capacity
Potential funding source	OEH Draft Climate Change Fund Strategic Plan

Service provider collaboration action details

The Cross Dependency Initiative (XDI)

The XDI Platform, supported by funding from the Office of Environment and Heritage, provides governments and business with risk analytics to optimise investments and assure climate resilience. The platform engages multiple parties across multiple sectors, in a single quantitative system, to engender collaborative solutions.

The platform, run through super computers, assesses the climate risk of individual assets and interdependencies between them; in particular, dependence on potentially vulnerable critical infrastructure providers. The software can perform complex cost benefit analysis for various adaptation scenarios, including providing multi-year projections of:

- Insurance cost / annual average risk cost
- Asset availability
- KPIs on customer and revenue disruption
- Adaptation cost benefit analysis
- Discounted cost-benefit and NPV
- Hazard impact allocations
- Asset vulnerability diagnostics

Source: http://xdi.systems/

Western Sydney stakeholders participate in an urban heat workshop

ACTION 15 CLIMATE ADAPTIVE TRANSPORT INFRASTRUCTURE AND SERVICES

Raise awareness among transport infrastructure providers regarding the important role that they play keeping people cool while they are travelling from one place to another, including providing access to employment, services and places of respite during a heatwave.

Transport infrastructure providers have an important role to play in minimising the impacts of heat on their customers; particularly vulnerable populations. If an elderly citizen cannot bear to wait outside in the heat for a bus to an air-conditioned respite area, they may end up staying home and putting themselves at risk.

A customer-focused approach to public transport that cares for passengers over their entire journey (including transfers) needs to be considered. Such an approach might include ensuring train stations are adequately sheltered and cooled, improving air conditioning on trains and buses, availability of water at transport nodes, and providing first and last-mile solutions for vulnerable individuals.

Improving the frequency and reliability of services is essential for increasing public confidence in transport services and ensuring passengers aren't waiting in the hot sun for longer than necessary. It is also important to explore how public transport can support emergency responses during heatwaves for example, providing bus vouchers to cooling centres on hot days.

Benefits

Well-designed, adaptive transport infrastructure plays a critical role in protecting passengers from the elements during heat events. Vulnerable communities who depend on public transport will benefit most; being better able to access services and places of respite.

Improving the amenity, reliability and therefore uptake of public transport will also have broader flow on effects for public health.

Action type

Suggested lead	Transport for NSW (transport infrastructure), local government (shelters)
Potential partners	WSU Institute for Culture and Society, University of Technology Sydney (UTS) Institute for Sustainable Futures, NSW Climate Adaptation Research Hub, Institute for Culture and Society
Delivery timeframe	0-2 years
Benefit or value	Preparation for urban heat, social benefits
Potential funding source	OEH Draft Climate Change Fund Strategic Plan

Transport action details

ACTION 16 DEVELOPMENT OF INNOVATIVE FUNDING MODELS FOR COOLING INFRASTRUCTURE

In the current growth environment, there are many different competing avenues for infrastructure funding. In order to fund necessary cooling infrastructure projects, we must explore application of value capture principles to understand the beneficiaries of urban cooling infrastructure and how they might contribute to its construction. Of specific interest is the water supply for expansion of green infrastructure maintenance across Western Sydney. Sustainable funding models will allow for appropriate cooling projects to go forward.

The Water Services Association of Australia has produced the Urban Water Reform[31] report outlining reforms to economic regulation and clarification of governance arrangements to allow for capture of value from investments. Sydney Water is currently creating a Western Sydney Regional Master Plan to plan for water supply to accommodate projected growth. This master plan should include concepts for blue infrastructure to support urban cooling and water supply for green infrastructure.

Benefits

Sustainable funding models for cooling infrastructure will help reduce organisational deprioritisation of green infrastructure and other cooling projects. The more cooling projects constructed across Western Sydney, the greater potential for reducing temperatures and enhancing liveability and health in Western Sydney.

Action type

Suggested lead	NSW Government Treasury
Potential partners	Property Council of Australia, NSW Health, NSW Chamber of Commerce, academic institutions
Delivery timeframe	3-5 years
Benefit or value	Mitigation of urban heat, collaborative relationships
Potential funding source	NSW Government Treasury

Innovative funding action details

Climate Adaptive People Shelters (CAPS)

Bus shelters are seldom designed with 'shelter' in mind; their location and construction is predicated on a model that focuses on the placement of advertising, safety, and the operational needs of transport authorities. The needs of some of the most vulnerable users like elderly, school kids, young families and the poor are often overlooked, particularly in light of increased exposure to urban heat and other weather extremes. This project aims to co-create and research the implications of climate adapted and smart urban infrastructure designs with a focus on re-imagining the old bus shelter.

The NSW State Transit Bus Infrastructure Guide advises that bus shelters should provide a comfortable, convenient, reliable, and safe service that is accessible to all while addressing the requirements of groups who are often most dependent on public transport and among the most vulnerable to the effects of urban heat.

The project addresses the complex challenges of exposure to urban heat and smart public transport infrastructure in order to achieve better solutions for the people who live in our cities. Better designed public infrastructure makes public space more liveable while also helping to create a city that is better connected and more affordable.

The first pilot CAPS shelter was completed in 2017 at Derby Street in Kingswood. The extended roofline of the shelter was designed using 3D solar modelling, to create a larger overhang to provide maximum shade cover in summer months. The shelter also maximises the benefits of cross flow ventilation, with the perforated rear screen and the roofline designed to expel heat before it can build up. The roof panel is also insulated to reduce heat radiation from the ceiling. Solar panels on top of the shelter provide power for integrated LED lighting, increasing safety and amenity at night time.

The project is a partnership between Penrith, Parramatta, Ashfield and Canterbury Councils, along with the University of Technology Sydney's Institute for Sustainable Futures, U.lab and Centre for Management & Organisation Studies, the NSW Climate Adaptation Research Hub and the Institute for Culture and Society at Western Sydney University. It has also been assisted by the NSW Office of Environment and Heritage, and supported by Local Government NSW through the Building Resilience to Climate Change funding program.

First CAPS shelter constructed at Derby Streeet in Kingswood (image credit: Penrith City Council)

3.4 NEXT STEPS

Urban heat poses a major threat to both liveability and human health in Western Sydney that is projected to worsen with changing climates. In taking action to reduce the risk from urban heat, Western Sydney must leverage the success of existing local cooling initiatives and planning efforts and expand upon them to enable efficiency at multiple scales.

STRATEGY GOVERNANCE – THE WORKING GROUP MODEL

The working group governance model promotes a high level of engagement among key stakeholders and helps create a genuine sense of ownership and responsibility for actions.

STEERING COMMITTEE

The Steering Committee will continue to meet after release of the strategy and serves as the leaders in implementing actions in the Take action, together strategic driver.

IMPLEMENTATION GROUP

WSROC will facilitate the establishment of an implementation group to guide implementation of the strategy and provide monitoring and evaluation of strategy and action implementation. This group will be established in 2018.

MULTISECTOR WORKING GROUPS

Three additional working groups will be formed in alignment with the remaining strategic drivers. Membership of the working groups will be established through an open call to participate across private sector, non-profit, and governmental organisations and through nominations by Steering Committee members of individuals from within their organisations. Working groups are to meet quarterly following establishment in 2018.

Proposed working groups are as follows:

1. Healthy and prepared
2. Cool with green space and water
3. Built environment and infrastructure (combining the *Design and plan to cool the built environment* and *Innovative and responsive infrastructure* strategic driver concepts)

At working group inception, WSROC will facilitate the selection of a group chair and affirm priority actions recommended in this strategy. The group will then establish a working group specific implementation plan and timeline and agree upon an initial 12 month term of reference for implementation. There will also be an opportunity for member organisations to 'host' the working group for a year to galvanise action and support logistics. Working groups will aim to have at least one achievement per quarter. Additionally, the proposed annual or biannual Urban Heat Research Consortium can serve as a platform for presentation of the progress of the working groups to a wider audience.

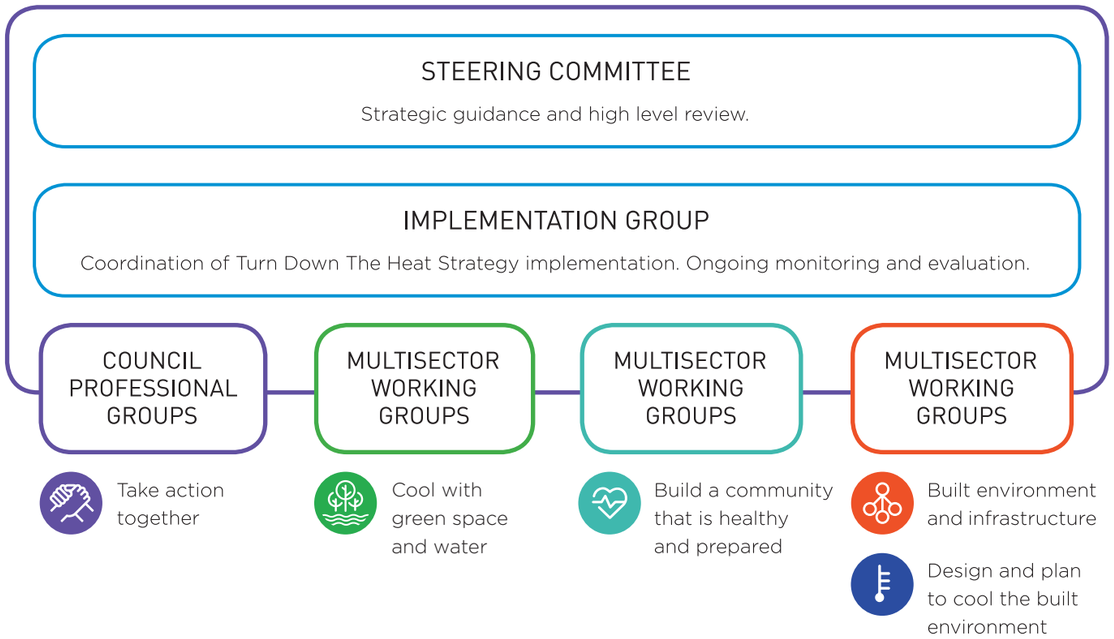
COUNCIL PROFESSIONAL GROUPS

The existing WSROC local council professional groups can serve as a useful forum for a conversation about the risks of heat across various areas of professional expertise. Members from the steering group or from the multi-sector working groups can present best practices and progress to raise awareness to a wider council staff audience.

A CALL TO ACTION

The complex challenges posed by urban heat will require cross-sector, cross-boundary and cross-agency approaches. As highlighted throughout this strategic plan, ongoing collaboration has been, and will continue to be, a critical success factor. WSROC and its strategic partners have a unique opportunity to catalyse action and build capacity across Western Sydney.

Implementing the Turn Down the Heat Strategy and Action Plan



GLOSSARY

TERM	DEFINITION
Adaptation	Projects and programs designed to reduce risk and help residents and organisations better cope with the impacts of heat
Albedo	Albedo is the measure of diffusive reflection of solar radiation out of the total solar radiation received by a body
DPE	NSW Department of Planning and Environment
Evapotranspiration	Evapotranspiration is the term used to describe the part of the water cycle which removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation. Evapotranspiration is not the same as evaporation
GBCA	Green Building Council of Australia
GSC	Greater Sydney Commission
IPCC	Intergovernmental Panel on Climate Change
Heatwave	A heatwave, as defined by the Australian Bureau of Meteorology, is a period of three or more consecutive days of high maximum and minimum temperatures which are unusual for that location
Hot days	Defined by the Climate Council as days between 30°C and 35°C
Very hot days	Defined by the Climate Council as days between 35°C and 40°C
Extremely hot days	Defined by the Climate Council as temperatures 40°C and over
Morbidity	Morbidity is a term used to describe incidence of an illness or disease or condition occurring in a specific area
Mortality - Heat Related	Heat related mortality rate is determined by the number of deaths classified as heat related by medical professionals
Mortality – All-cause	All-cause mortality is determined by the total number of deaths in a given time period. In the case of urban heat, high temperatures can exacerbate existing conditions and cause premature death, but the cause of death will usually be recorded as the existing condition
OEH	NSW Office of Environment and Heritage
SLERA	State Level Emergency Risk Assessment
UFCCC	United Nations Framework Convention on Climate Change
Urban Heat Island (UHI)	The Urban Heat Island Effect (UHI) is a local climate change phenomenon whereby urban areas present higher air temperatures than their rural proximities. The difference is often 3-4°C, but higher peak differences can reach 10 °C.
Urban Heat Mitigation	Projects and interventions that seek to reduce the root cause of urban heat (and therefore the temperature) through either an increase in green canopy, use of more building and paving reflective materials, use of irrigation and water features
WSROC	Western Sydney Regional Organisation of Councils
WSU	Western Sydney University

ACKNOWLEDGEMENTS

WSROC would like to thank those who contributed throughout the development of the Turn Down the Heat strategy and action plan, we look forward to continuing to work with you.

Turn Down the Heat program Steering Committee:

Associate Professor Dr Stephen Corbett, Director of the Centre for Population Health, Western Sydney Local Health District

Barbara Schaffer, Principal Landscape Architect, NSW Government Architects Office

Beck Dawson, Chief Resilience Officer, Resilient Sydney

Charles Casuscelli, Chief Executive Officer, WSROC

Greg Dyer, former Chief Executive Officer, City of Parramatta Council

Professor Phillip O'Neill, Director, Centre For Western Sydney, Western Sydney University

Roderick Simpson, Environment Commissioner, Greater Sydney Commission

Suzanne Dunford, Strategic Delivery Manager - Climate Change Adaptation, NSW Office of Environment and Heritage

WSROC would specifically like to thank the **urban heat working group**, consisting of professionals in the areas of planning, environment and sustainability from Blacktown, City of Canterbury Bankstown, Cumberland, Liverpool, City of Parramatta and Penrith City councils.

Contributors:

202020 Vision

AECOM

Arup

Blacktown City Council

Blue Mountains City Council

Bluescope

Bridge Housing

Camden Council

Campbelltown City Council

City of Canterbury Bankstown

City of Parramatta Council

City of Sydney

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Conservation Volunteers

Cooperative Research Centre for Low Carbon Living

Cumberland Council

Elton Consulting

Endeavour Energy

Fairfield City Council

General Mills

GHDWoodhead

Greater Sydney Commission

Hawkesbury City Council

Hawkesbury Earth Care Centre

Hawkesbury Institute for the Environment

Health and Arts Research Centre (HARC)

Landcom

Liverpool City Council

Local Government NSW

Macarthur Centre for Sustainable Living

Nepean Blue Mountains Local Health District

NSW Government Architects Office

NSW Health

NSW Office of Environment and Heritage

NSW Department of Planning and Environment

Optus

Parramatta Climate Action Network

Penrith City Council

Resilient Sydney

South Western Sydney Local Health District

Splash Network

Stockland

Sydney Water

The Bravery

The Walking Volunteers

Unfolding Futures

University of New South Wales

University of Sydney

University of Technology, Sydney Institute for Sustainable Futures

UrbanGrowth NSW

Western Sydney Diabetes

Western Sydney Local Health District

Western Sydney Regional Organisation of Councils

Western Sydney University

Wollondilly Shire Council

Strategy development

This strategy was developed by WSROC and AECOM:

Charles Casuscelli, WSROC

Judith Bruinsma, WSROC

Adam Davis, AECOM

Rebecca Miller, AECOM

Suzanna Remmerswaal, AECOM

Theresa O'Neil, AECOM

Design: Andrew Derkatch and Albert Basha, AECOM

REFERENCES

1. Zander, K. et al. Heat stress causes substantial labour productivity loss in Australia. *Nature Climate Change,* 5(7), 647–651; 2015
2. Schaffer, A., Muscatello, D., Broome, R., Corbett, S. & Smith, W. Emergency department visits, ambulance calls, and mortality associated with an exceptional heat wave in Sydney, Australia, 2011: a time-series analysis. *Environmental Health,* 11(3); 2011
3. Sydney Water and University of NSW. *Cooling Western Sydney;* 2017
4. NSW Department of Planning & Environment. *New South Wales state and local government area population projections;* 2016
5. Climate Council. *The critical decade – New South Wales climate impacts and opportunities;* 2012
6. Australian Bureau of Meteorology. Climate Data Online; 2017. Retrieved from: http://www.bom.gov.au/climate/data/
7. City of Parramatta. Parramatta Heat Maps interactive mapping; 2015
8. Metherell, L. NSW heatwave: National energy grid survived the weekend, will it last the summer? ABC News; 9 January, 2018
9. Arlington, K. Sydney weather: How urbanisation creates hot microclimates in our suburbs. *Sydney Morning Herald;* 11 February, 2017
10. Western Sydney Regional Organisation of Councils. *Scorching summer calls for heat-safe planning*; 1 February, 2017
11. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2014: Impacts, Adaptation, and Vulnerability. *Fifth Assessment Report;* 2014
12. NSW Office of Environment and Heritage. *Urban heat: Climate change impact snapshot;* November, 2015
13. NSW Office of Environment and Heritage. *Metropolitan Sydney: Climate change impact snapshot;* November, 2014
14. Deloitte. *Building resilience to natural disasters in our states and territories;* 2017
15. Osmond, P. & Sharifi, E. *Guide to Urban Cooling Strategies,* CRC for Low Carbon Living; 2017
16. Wilson, L. A. *Heatwaves and the older Australian population: A mixed methods study,* University of Sydney; 2016
17. Steffen, W., Hughes, L. & Perkins, S. *Heatwaves: Hotter, longer, more often,* Climate Council of Australia Ltd; 2014
18. The Climate Institute. *Dangerous Degrees;* 2013
19. Western Sydney Regional Organisation of Councils. *Issues: Health;* 2016
20. Western Sydney Diabetes. *Taking the heat out of our diabetes hotspot;* 2017
21. Resilient Sydney. *A strategy for city resilience;* 2018
22. Interview with Endeavour Energy; 17 November 2017
23. Harmsen, N. *South Australian blackout costs businesses $367m, feats summer outages on way, lobby group says,* ABC News; 9 December, 2016
24. Kendal, D., Farrar, A., Plant, L., Threlfall, C.G., Bush, J., & Baumann, J. *Risks to Australia's urban forest from climate change and urban heat,* Clean Air and Urban Landscapes Hub; 2017
25. Levy, M. Thousands of bats drop dead from trees in NSW Heat Wave, *Sydney Morning Herald;* 14 February, 2017
26. City of Parramatta. *Cool Parramatta;* 2016. Retrieved from: https://coolparramatta.com.au
27. NSW Office of Emergency Management. *State Level Emergency Risk Assessment* (SLERA); 2017
28. NSW Office of Environment and Heritage. *Impacts of land-use change on Sydney's future temperatures;* 2015
29. Benns, M. & Brennan, R. Trees being planted in Western Sydney to keep residents cool. *The Daily Telegraph;* 21 October 2017
30. AECOM. *Green infrastructure – a vital step to Brilliant Australian Cities;* 2017
31. Frontier Economics and Water Services Association of Australia. *Doing the important, as well as the urgent; reforming the urban water sector;* 2015

WSROC

The Western Sydney Regional Organisation of Councils' (WSROC) mission is to build collaboration between local governments across Greater Western Sydney, promoting Western Sydney, its people and places, through advocacy, business improvement, strategic leadership, research and partnerships. WSROC has facilitated the development of this strategy.

Address: PO Box 63 Blacktown NSW 2148
Phone: 02 9671 4333
Web: wsroc.com.au
Email: info@wsroc.com.au

facebook.com/WSROC
@WSROC_Australia
Linkedin.com/company/westernsydneycouncils