

PENRITH



COOLING THE CITY STRATEGY

August 2015

PENRITH
CITY COUNCIL

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Why do we need a **COOLING THE CITY** Strategy?

The urbanisation of our cities, along with predicted changes to our climate and an ageing population mean that urban heat is becoming an increasingly significant issue for cities right across the world. Heatwave related deaths in Australia's cities are predicted to more than double in the next 40 years (Nicholls, 2008). The Climate Commission Report, *The Angry Summer (2013)*, suggests extreme weather events dominated the 2012-13 Australian summer, including record breaking heat, and that extreme hot weather is highly likely to become even more frequent and severe in Australia.

Taking action to cool the city, in conjunction with supporting the community to adapt to a changing climate, is increasingly important, given the consistent projections of increasing heatwaves and the number of extreme temperature days for the Western Sydney region. This may have a serious impact on our City's liveability and its desirability to residents, businesses and investors.

In light of these challenges it is important that we focus on identifying opportunities to respond to urban heat. This Strategy relies on a strong research base to understand urban heat within the Penrith Local Government Area (LGA) and to develop a broad range of actions that will work together towards cooling the City.

The Penrith community wants action to cool the City. The recent Penrith Progression:

“ *A Plan for Action (2015)* says:

‘Compared to metropolitan Sydney, Penrith's micro-climate is hotter and drier in summer, and colder with frosts in winter. Our buildings and streets must be designed to minimise urban heat island impacts. Opportunities to cycle and walk will be supported by access to drinking water, and shady pathways. Tree-lined streets, verandas and awnings will provide cooling and shelter from the sun. Water play and connections with water will become essential elements of our City Centre. Our buildings and open space must respond to our cultural identity as a River City and contribute to cooling down Penrith, so it remains a destination of choice, where people want to live, work, play and invest.’

”

This Strategy aims to consolidate existing work by Council to cool the City. Tree planting and landscaping is one of the most successful approaches being taken across the world. Programs such as the Great River Walk, The Nepean River Vegetation Management Plan, the redesign of the Civic Arts Precinct, Council's Bushcare program, and the maintenance and renewal of parks, all contribute to cooling the City.

The evidence gathered to support the development of this Strategy will help Council to pinpoint areas where existing Council programs and funding should be directed to achieve multiple outcomes, including targeted cooling. There is also significant work being undertaken by Council that can, with refinement, work to achieve multiple objectives including cooling.

This Strategy draws upon existing works programs and adopted strategies as well as recommendations from expert consultants' reports to make suggestions for various cooling activities. Recommended actions for Penrith are included in the "Opportunities for Penrith" section of this Strategy. Council will also draw upon the evidence gathered and presented in the Strategy to seek external grant funding to trial and implement various cooling techniques and strategies across the City.

Council can work to address the impacts of urban heat in Penrith; but obviously the issue is not defined by political boundaries. The impacts of urban heat are regional and we need a consolidated multi-jurisdictional effort to effectively manage them. Council will work to establish and build on partnerships with key stakeholders including the Western Sydney Regional Organisation of Councils (WSROC), NSW State Government and universities.



PURPOSE

of the Strategy

To identify strategies to cool our City and region in a way that improves liveability and prioritises protection from heat for people and communities.

Objectives

- to maximise community awareness and understanding of the effects of heat and the importance of cooling the Penrith LGA
- to encourage greater appreciation of green infrastructure and green spaces in the LGA and their cooling benefits
- to implement the identified actions within the Strategy giving priority to heat vulnerable areas
- to identify ways to adapt existing projects and activities that will work towards cooling the Penrith LGA, and identify new projects.

Principles

- **Community engagement** – work with the community to build a shared vision for a cool liveable city
- **Collaboration** – work closely with internal and external stakeholders for maximum leverage and from the earliest stages of project development
- **Sustainability** – consider the long term implications of decision making in terms of inter- and intra-generational equity, and consider the precautionary principle in project decision making
- **Efficiency** – look for opportunities to refine existing projects and activities to meet the objectives of this Strategy

Responsibility

Council's Organisational Performance and Development Department is responsible for monitoring and reporting on the implementation of this Strategy, and for reviewing the Strategy so it remains current.

PENRITH CITY

Penrith City is located on the western edge of Sydney and covers 404km². The City's two major commercial centres are Penrith and St Marys, with Kingswood emerging as a 'specialised' centre, focussing on health and education.

Like many other large LGAs, Penrith is made up of many communities and cannot be treated as a single homogenous community. Most of the City's urban area is residential, with some commercial and industrial land. Significant parts of the City remain as rural and rural-residential areas with distinctive characteristics.

Penrith is a growing regional city. Between the 2006 and 2011 Census, the population increased by more than 6,000 people to a total current 2014 estimated resident population of 194,134. This growth is forecast to continue into the future with a population of 223,631 expected by 2031.

New release areas, including Thornton, Jordan Springs, Caddens and Mulgoa Rise, will help to realise the 25,000 new homes due to be delivered in Penrith over the next 20 years. The age structure of the population is also changing with a shift towards an ageing population. Between 2011 and 2020 the number of people aged over 60 in Penrith City is expected to increase by more than 30%. This sector of the population is considered one of the most vulnerable to extreme temperatures.

POLICY AND PLANNING FRAMEWORK

The *Cooling the City Strategy* fits under a broader integrated planning framework for the City. Our *Community Plan* identifies the community's long term aspirations for the City. It looks beyond the next 10 years, setting out strategies to achieve the outcomes the community is seeking. *Council's Delivery Program*, our 4 year work program, includes the annual *Operational Plan*. Together these set out services, activities and actions Council will deliver each year to implement the *Community Plan*.

The *City Strategy* seeks to help build a sustainable future for the City and our community, by examining the key issues facing us over the next 10 to 20 years and outlining how Council will respond. The issues and policy responses inform the *Community Plan* and *Delivery Program*. This document brings together a range of Council's adopted planning strategies and action plans.

The issue of heat has already been recognised within the *City Strategy* as an area that will require attention in coming years, with an adopted goal to 'increase green cover, shade and landscaping to 'cool down' Penrith' (E14).

The *Cooling the City Strategy* also relates to, and must be considered in conjunction with a range of other Council policy and strategic documents. A summary of these is included in Appendix 2.



Urban **HEAT** Island Effect

PENRITH CITY

As urban development occurs, it usually replaces natural land surfaces and vegetation with hard structures like roads, footpaths, car parks and buildings. These surfaces absorb much more heat than vegetation and encourage rainfall to run off the surface, leaving little moisture in the ground. This means there is less opportunity for evapotranspirative cooling to occur like it would in a natural landscape. A high density of non-porous and non-reflective surfaces, such as roof tiles, concrete and asphalt in an urban area can also trap the absorbed heat so that at night temperatures do not drop significantly, providing limited respite from the daytime heat.

Other sources of heat in an urban environment (such as waste air from air conditioners and heat created from the engines of vehicles) combine with trapped absorbed heat to make urban areas significantly hotter than surrounding, less urbanised areas. This phenomenon, known as the Urban Heat Island effect (UHI), causes cities to become islands of heat.

The UHI acts to intensify heat waves in cities, increasing health risks to the community and increasing the demand for air conditioning, which in turn emits more waste heat into the atmosphere, perpetuating the problem.

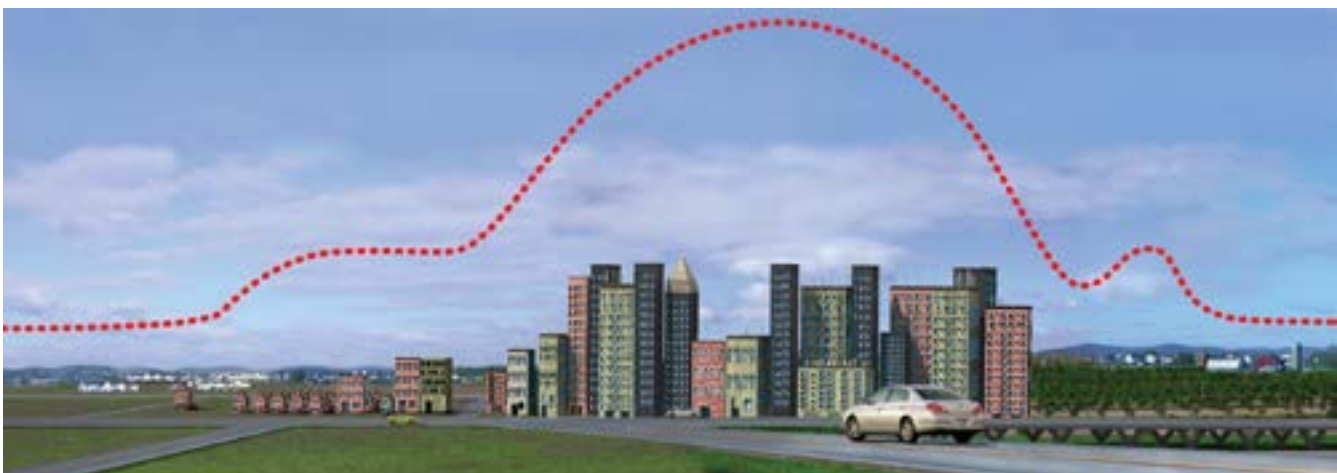


Figure 1: Image courtesy of Heat Island Group, Lawrence Berkeley National Laboratory.

INCREASING HEAT in the Penrith area

The Penrith LGA
is expected to
become warmer,
with more hot
days and fewer
cold nights

Penrith is part of the Sydney Basin, which covers a significant portion of the central east coast of NSW. Penrith sits within the lower altitude part of the basin, with the elevated terrain of the Blue Mountains to the west. The basin has significant effects on the climate of Penrith.

The topography of the area means that sea breezes from the east don't reach areas of western and south-western Sydney, including Penrith. This leads to consistently higher temperatures and lower rainfall in Penrith than in the more coastal parts of Sydney.

In addition, Australia has generally been getting warmer over the last 50 years. The most recent modelling by the NSW Office of Environment and Heritage (OEH) shows that the region is projected to continue to warm into the future. Since 1960 the average temperature across Australia has risen by 0.7°C. Since the 1970s every decade has been as warm if not warmer than the previous (NSW OEH, 2011). Following this trend. While the frequency and intensity of heat waves is attributed to a changing climate, the Urban Heat Island (UHI) effect is due to landscape modification and vegetation removal as a result of development and land use changes (Jacobs & Delaney, 2015).

Sydney experienced its second warmest year on record in 2014, following its warmest year in 2013, with well below average rainfall. The persistently warm temperatures were a result of several heatwaves. The warmest days on average across the whole of Sydney were experienced at the Penrith Lakes weather station, which recorded a mean temperature over the year of 25.2°C, an increase of 0.7°C from average Bureau of Meteorology (BoM, 2015). The highest temperature recorded at Penrith Lakes in 2014 was 44.9°C. The mean minimum temperature recorded in 2014 was 12.8°C, an increase of 0.5°C from average, with the whole year exhibiting above average temperatures.

Currently areas of Western Sydney experience 10-20 hot days on average, with projections for an additional 5-10 days per year in the near future, increasing to over 10-20 additional hot days per year by 2070 (OEHL, 2014). This is likely to result in more extreme and longer lasting heatwaves in summer.

A thermal image of the LGA, obtained under licence from the CSIRO (see Appendix 1), was taken at 10:30am on 2 February 2011, the fourth consecutive day over 35°C. The maximum ambient temperature recorded at Penrith Lakes weather station that day was 41.8°C. However analysis of the thermal image shows land surface temperatures that range between 40.49°C, with localised hotspots identified that are another 5°C hotter again. This thermal image also shows that the cooling effect of vegetation across the LGA is significant, offering temperature reductions of up to 20°C compared to areas bereft of vegetation.

The period from 30 January to 6 February 2011 was classified by the BOM as a heatwave across Sydney. The highest maximum and highest minimum temperatures for the entire year were recorded the day before the satellite image was taken, ensuring the best circumstances to record heat retention. While 10:30am was not the ideal time to record maximum temperature, as it was likely that temperatures increased later in the day, there was enough of a difference recorded to identify those sites where heat retention may be a problem.

It should be noted that although this image was taken in 2011, on average the temperatures across Sydney have only increased since this time.

Heat analysis of hotspots that coincided with potentially vulnerable communities in the Penrith LGA was undertaken to support the development of this Strategy. It focussed on the Penrith CBD and suburbs of St Marys, Penrith City Centre, Kingswood, Cranebrook and Glenmore Park.



Heat, **HEALTH** & wellbeing

The impacts of increasing incidences of extreme heat are numerous and include financial, environmental and social effects. Of all the potential impacts associated with increased heat, the health impacts are of particular concern to Council. The most common health problems include dehydration, heat stress, heat stroke, respiratory problems and dementia.

There is clear evidence to show certain sections of the community are more vulnerable to heat exposure than others. Risk is determined by a combination of personal, social and environmental factors including age, general health, activity levels, social isolation and socio-economic status (NSW Health website).

A recent study that looked at the spread of low income housing across Australia found low income households are regularly concentrated in the parts of Australia's cities with the highest land surface temperatures. This means the people most vulnerable to heat related health impacts are often living in areas with the highest heat exposure and lowest levels of vegetation (Barnett et al, 2013). Research undertaken to support the development of this Strategy indicates that this is the case in Penrith.

A range of social service providers were interviewed as part of the heat vulnerability analysis undertaken to support this Strategy. Although those interviewed were only a portion of the range of community services on offer in the Penrith LGA, the comments illustrate the problems facing service providers and vulnerable community members in relation to extreme heat events. There was general agreement among the service providers that their target client groups were particularly vulnerable. These groups included people who are house-bound as a consequence of compromised health and mobility (Jacobs & Delaney, 2015).

The service providers identified groups who they see as vulnerable to heat, including:

- People that fail to identify with the 'at risk' community and therefore do not heed warnings. As a consequence, these people often engage in risky behaviour on hot days. This group also includes those suffering from mental illness such as dementia.
- Homeless people cannot escape the heat and are often unwelcome in public spaces such as shopping centres where cooling may be available. In addition, access to drinking water can be an issue.
- Potential victims of domestic violence (mainly women and children). Penrith has a Domestic Violence Network which reports observing increased incidences of domestic violence during heat waves.
- Multiple Sclerosis (MS) sufferers.
- People with spinal cord injuries and Motor Neuron Disease as they cannot regulate their body temperatures.
- Socially disadvantaged people without access to public transport.
- Babies and toddlers are at an increased risk if their parents are not monitoring them during a heat wave.
- People with compromised respiration. Heat waves tend to exacerbate the ill-effects of reduced air quality during bush fires for those with respiratory problems.
- Divorced or widowed older women tend to reside in pockets within the social housing community. They are generally on low incomes and are impacted by the heat. However, because they have remained in larger family homes they are currently required to pay the Vacant Bedroom Charge to the NSW Government. This in turn reduces their ability to pay for additional costs of running air conditioning.
- Residents of social housing in areas of Cranebrook are vulnerable to heat because there is a combination of a lack of household resources and poorly designed housing.



HEAT & Liveability

Liveability is a concept which addresses many aspects of urban life. A very broad range of factors contribute to making a place liveable. The factors that contribute to liveability also vary for individuals depending on their circumstances and life-cycle stage. The *State of Australian Cities Report (2010)* defines liveability as:

The degree to which a place, be it a neighbourhood, town or city, supports quality of life, health and wellbeing for the people who live, work or visit. Cities considered to have a high degree of liveability tend to have a high level of, and widespread accessibility to, amenity. Amenity includes features such as open and green space; educational, social, cultural and recreational facilities.'



Initiatives to cool the City will also have a myriad of other benefits, including significant improvements in liveability for some of the most vulnerable members of our communities.

The Australian Research Centre of Excellence for Climate System Science found new residential areas on the fringes of Sydney could see temperatures rise between 1.1-3.7°C, while the rural areas near these new suburbs could see increases of 0.8-2.6°C. Existing urban areas closer to the CBD will see likely rises of 1.1-2.5°C. Research undertaken to support the development of this Strategy clearly indicated that the design of new developments has a significant effect on the localised land surface temperatures of those areas. For example a thermal image of parts of Glenmore Park shows some of the hottest land surface temperatures across the LGA, with few areas of respite from heat easily accessible to the community.

The 2011 Census indicated that Penrith has a population of 184,589. The Penrith Urban Study and Strategy, indicates that by 2031 the Penrith LGA population could increase by approximately 20%. The number of dwellings will need to grow to house the increase in population. It is anticipated that 12,000 new dwellings will be developed within established urban areas and 13,000 new dwellings will be developed within new release areas to accommodate the increase in population. Any future development, whether it is in existing urban areas or in new release areas, will exacerbate the propensity for urban heat island impacts on our communities and affect the liveability of the City.

There is an established and well researched link between urban greening, heat and the liveability of a city. Research found that tree canopy cover in the five priority areas was approximately 10%, while hard surface cover was 32%. This is low compared to an Australian-wide analysis of 139 LGs undertaken by the Institute for Sustainable Futures (20:20:20 Vision 2014), where the average tree canopy cover was 39% and average hard surface cover was 8% (Figure 2).

TREE COVER COMPARISONS

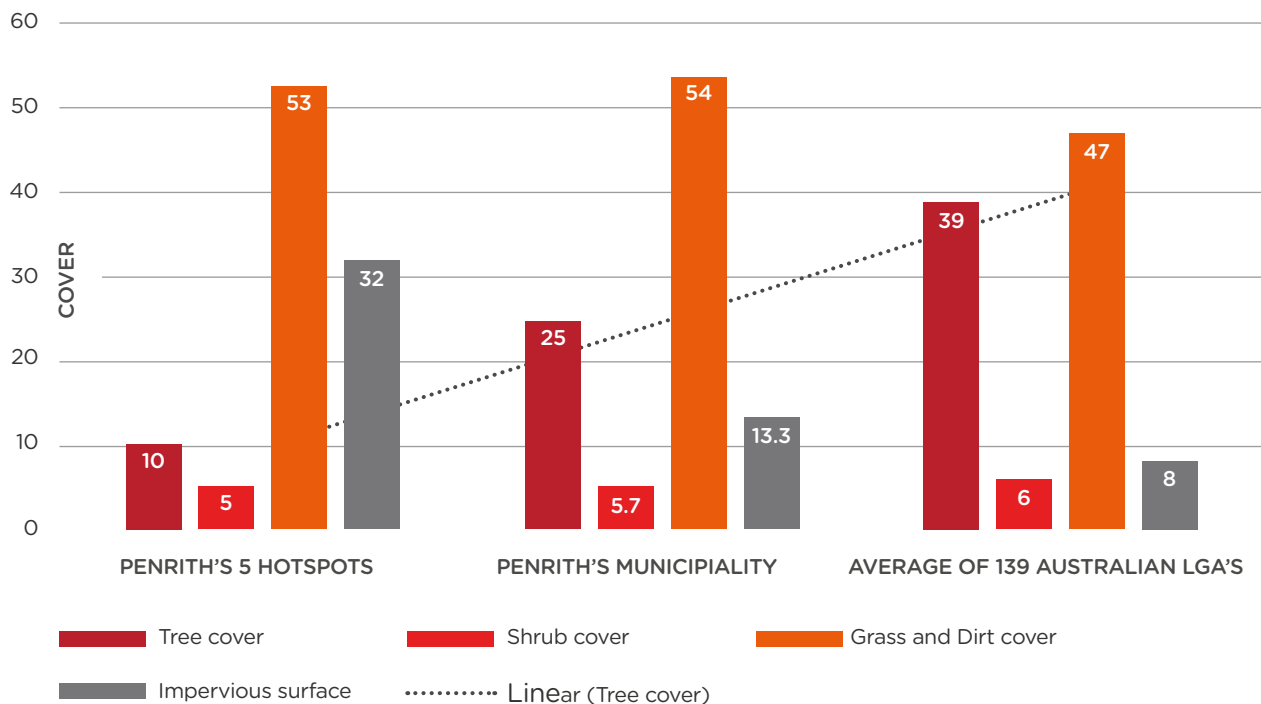


Figure 2: Tree canopy cover comparisons for Penrith and other Australian Local Government Areas



Conclusions drawn from **PENRITH BASED RESEARCH**

Significant research has been undertaken within the Penrith LGA to help Council understand the significance of the urban heat island effect and to help us develop this Strategy. Specifically the research sought to identify vulnerable communities within our City and to identify where these are co-located with hotspots. The research also identified a range of opportunities that Council could consider for inclusion within the Strategy to focus our efforts to cool the City to have the greatest impact.

In general, the research concluded the following:

- The whole of the Penrith LGA experiences high temperatures.
- Existing vegetation has a significant heat mitigation effect.
- Irrigated vegetation is more effective at providing cooling than non-irrigated vegetation.
- Car parks, Commercial and Industrial Zones are generally the hottest.
- The following areas should be prioritised for protection against heat:
 - bus stops/shelters
 - public exercise areas
 - west facing pedestrian areas around schools
 - main intersections
 - car parks
 - footpaths, verges, roads, roundabouts (road reserves)

As the majority of UHI covers privately owned land, significant community engagement is required to encourage cooling on private property.

The research also demonstrated that there are some areas across the Penrith LGA that are significantly cooler than others. These areas have a number of features in common, including:

- Water either on the surface or stored in the soil profile;
- Ground cover that is permeable and grassed;
- Tree cover.

Surface water bodies such as the Nepean River, South Creek and Blue Hills Wetlands show significantly cooler temperatures than adjacent areas. Artificial water bodies produce a similar cooling effect on the local environment. This cooling is evident in parts of Penrith Lakes, Waterside Estate, and Glenmore Loch in Glenmore Park.

The cooling effect of keeping water in the surface soil profile is also evident in irrigated areas, most often used for sporting activities. Golf Clubs in Glenmore Park and St Mary's as well as irrigated parks and ovals, such as Centrebet Stadium, are much cooler than the surrounding areas. Similar patterns are also clear at Penrith Waste Water Treatment Plant, where outflow from the water treatment process is irrigating the surrounding grassed areas.

Strategies to mitigate URBAN HEAT

There are a range of strategies available to assist with managing urban heat that can broadly be broken down into green and non-green options, or perhaps living and non-living strategies. It is important to be aware of the full range of these options available to assist with urban heat management, as a mix of solutions will be required to achieve maximum impact and to cater for the range of situations that will be encountered. The broad categories that actions can be grouped under are listed below and explained in more detail later in this section.

- Green Infrastructure;
- Water Sensitive Urban Design (WSUD);
- Increased Albedo / Reflectivity;
- Policy & Planning
- Community Engagement.

It should be noted that in times of extreme heat, the ability of the mitigation strategies proposed in this document may not be sufficient to reduce ambient temperatures to a comfortable level. There is an important role that large commercial or recreational developments such as shopping centres, clubs or cinemas can play within the community in providing places of respite and refuge from extreme temperatures. This should be further recognised in new developments by the provision of cool public refuge space that is not contingent on the community spending money to visit.

There is no single department or service that would take carriage of urban heat mitigation across Council. It is a cross-Council issue that will require various services to take responsibility for implementation of actions.

Green Infrastructure

Green Infrastructure (GI) is becoming increasingly recognised by cities across the world as an effective way to address the impacts of urban heat. Green infrastructure can be defined as 'the network of designed and natural vegetation found in our cities and towns, including public parks, recreation areas, remnant vegetation, residential gardens, street trees, community gardens, and innovative and emerging new urban greening technologies such as green roofs and walls (VCCCAR, 2013)'.

GI is a popular management strategy for government due to the range of co-benefits that it provides. So, while GI is often an effective way to reduce heat in urban environments, at the same time it can also:

- Assist with flood alleviation and management;
- Improve stormwater quality;
- Lead to increased productivity of workers;
- Have positive impact on people's health and wellbeing;
- Provide habitat and biodiversity benefits;
- Provide attractive public spaces;
- Provide opportunities for recreation and leisure;
- Have positive impacts on local tourism;
- Encourage economic growth and investment;
- Provide opportunities for urban agriculture or food gardening
- Improve mental and physical wellbeing.

Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is the sustainable management of water in urban areas through integrated design. It takes into account all of the elements of the urban water cycle including: potable (drinking quality) water, rainwater, wastewater, stormwater and groundwater.

WSUD includes technologies such as water efficient fittings and appliances, rainwater tanks to reduce potable water consumption and costs, bio retention systems (rain gardens), swales, wetlands, proprietary devices and other approved site-specific measures to reduce pollution from stormwater entering local waterways (*Penrith City Council Water Sensitive Urban Design Policy*).

The foundation of urban heat mitigation is the retention of water in the landscape. A planning and policy framework that recognises the importance of, Water Sensitive Urban Design affords planners and developers opportunities to create effective and long-term cooling strategies (Jacobs & Delaney 2015). WSUD should ideally go hand in hand with the implementation of Green Infrastructure. Together they can influence air temperature, surface temperature; wind speed and humidity, which all influence human thermal comfort (Green Cities and Micro-Climate 2014).

Increased albedo (reflectivity)

Reflective and light coloured surfaces on roadways, walkways and roofs are an important UHI mitigation strategy. Surfaces store solar energy as heat and release it, either through contact (conduction) or into the air (convection). The darker the surface the more potential it has to store heat, eg asphalt, tar, gravel, dark tiles, dark

paint. A light-coloured or reflective (shiny) surface has very small potential to store heat. Surfaces that reflect solar energy tend to stay cooler themselves, release less heat into the surrounding air and allow for night time cooling in a city (Hewitt & Mackres 2014).

The co-benefits of reflective or light-coloured surfaces in urban areas that include:

- increased road or footpath visibility at night
- improved water quality, and
- road/path longevity due to decreased heat stress.

Cool pavement's are those that use materials that reflect more solar energy, enhance water evaporation, or have been modified in some way to remain cooler than conventional pavements such as asphalt and impervious concrete. Pavements can be used for a variety of purposes including roads, parking and footpaths. Urban environments typically have a large area covered by pavements, making them important to consider in any cooling strategy.

Cool pavements can be created with existing paving technologies (such as asphalt and concrete) as well as newer approaches such as the use of coatings or grass paving. Some permeable pavements can also act as cool pavements due to higher infiltration.

Cool roofs are those with a high albedo, or a high solar reflectance, helping to reflect sunlight and heat away from a building and reducing roof temperatures. Some of these roofs can also emit absorbed heat back into the atmosphere at a higher rate than conventional products, helping to keep the roof as cool as possible. Cool roofs can be up to 30°C cooler than conventional roofs during the height of summer (US EPA 2008).

Strategies to mitigate **URBAN HEAT** continued...

Policy and Planning Controls

Urban heat island mitigation strategies can be included in policies or regulations, such as:

- planning controls for new developments specifying requirements such as reflective surfaces, porous pavements, WSUD, open/green space
- procurement of cool products – eg reflective roofing, porous pavement, sustainable building products
- target setting – eg % of canopy cover, open space, heat reduction, reflective roof surfaces
- tree and landscape rules and standards
- stormwater project design
- comprehensive plans and design guidelines, and
- green building standards.

Community Engagement

Community engagement activities are crucial to inform the community about the risks of heat and to encourage heat mitigation on public and private.

A variety of community engagement techniques have been effectively employed throughout the world, including:

- incentives - from governments, utilities and other organisations can include loans, tax breaks, product rebates, grants and giveaways.
- ownership
- information
- demonstration projects







Opportunities in **PENRITH**

Opportunities to cool the City can be divided into low cost actions that can start to be implemented immediately within current budgets and work programs, and those where more significant funding will be required for implementation over a longer period of time.

Breaking the actions down in this way allows Council to focus on those areas where we can begin to make an immediate impact within the City, while still using this time to investigate external funding opportunities, pilot projects and partnerships with other organisations for some of the more ambitious projects.

Funding for future actions will need to be considered as part of Council's Integrated Planning and Reporting program. Our next four year Delivery Program and associated capital works program will be developed in mid 2016.

Actions have been identified to fall within one of six strategy areas:

- Policy & Planning
- Community Engagement
- Green Infrastructure
- Water Sensitive Urban Design
- Increased Reflectivity, and
- Social.

LOW COST ACTIONS FOR IMMEDIATE IMPLEMENTATION

POLICY & PLANNING		
Ref.	Action	Responsibility
P1	Investigate a regional approach to increasing green infrastructure with NSW State Government and WSROC	Sustainability, City Planning
P2	Consider heat in the design and development of Council parks, including the City Park	Design & Projects, Place Management, Parks
P3	Advocate to the Local Area Health Service for improved reporting of health related illness and hospital admission data in relation to heat events	Sustainability
P4	Work with the Department of Education to undertake an assessment of west facing pedestrian areas around schools and identify opportunities to provide shade and cooling	Sustainability
P5	Consider heat management opportunities in the planning for infrastructure to support new communities	City Planning
P6	Ensure trees removed by consent have replacement conditions wherever practicable	Parks, Development Applications
P7	Review and amend standards and conditions relating to street trees in new developments including planting standards, time of planting, maintenance plans, auditing and enforcement	Parks, Development Applications, Waste and Community Protection
P8	Advocate to the State Government for improved consideration of heat in State policies and legislation	Development Applications
P9	Advocate to the UDIA, Property Council and the broader development industry to prioritise heat management strategies in development	Development Applications
P10	Consider heat impacts on the community are considered in the choice and provision of sporting and recreational field surfaces	Recreation
P11	Undertake a street tree inventory of the LGA (i-tree analysis) as part of the Asset Management program and update regularly	Sustainability, Parks
P12	Develop an appropriate tree species list for urban heat mitigation in Penrith	Parks

POLICY & PLANNING

Ref.	Action	Responsibility
P13	Undertake a heat analysis to support the Public Open Space Reinvestment Project (commenced)	Financial Services
P14	Maximise the opportunity for planting replacement street tree's in Queen Street St Marys through appropriate species, spacing and complementary technologies (eg WSUD)	Place Management, Design & Projects,
P15	Work with developers to identify opportunities for deep soil zones and canopy tree planting, and to showcase and trial cooling strategies through the Urban Design Review Panel and pre-lodgement meetings	Development Applications

COMMUNITY ENGAGEMENT

Ref.	Action	Responsibility
E1	Develop educational resources to help home and business owners and schools make their properties 'cooler', including selection of appropriate tree species and cool materials	Sustainability, Parks
E2	Develop educational resources to support social service providers in educating their clients about responding to heat events	Sustainability, Community & Cultural Development
E3	Investigate and support grants for community and stakeholder collaborative projects that encourage shade and cooling strategies	Sustainability
E4	Partner with relevant stakeholders including 20:20:20 Vision	Sustainability, Design & Projects
E5	Use existing networks and events (eg Seniors Week and Children's Week events) to provide information to the community	All Council
E6	Participate in and promote National Tree Day and other tree planting initiatives and where possible align their implementation with priority hotspot areas	All Council
E7	Engage with the community to encourage tree planting and maintenance	Sustainability, Parks, Environmental Health

GREEN INFRASTRUCTURE

Ref.	Action	Responsibility
G1	Investigate opportunities to work with NSW Department of Family and Community Services – Housing, and community housing or grants to provide Green Infrastructure in priority areas	Sustainability, Parks, Community & Cultural Development
G2	Investigate opportunities for plantings within road reserves and public space	Parks, City Works, Engineering Services

WATER SENSITIVE URBAN DESIGN

Ref.	Action	Responsibility
W1	Look for opportunities to showcase WSUD in Council projects	Environmental Health, Engineering Services
W2	Investigate alternative water supplies (eg stormwater capture, sewer harvesting) to ensure adequate soil moisture during warm months	Environmental Health, Parks
W3	Provide training for relevant staff in WSUD and 'Green Engineering / Infrastructure' to build capacity within Council	Environmental Health

INCREASED REFLECTIVITY

Ref.	Action	Responsibility
R1	Include provisions which address roof colour and reflectivity	City Planning
R2	Identify Council owned buildings that could be painted to become light coloured or heat reflective roofs and cost iterations of implementation (eg. 20%, 50%, 100%)	City Works

SOCIAL

Ref.	Action	Responsibility
S1	Liaise with the NSW Department of Family and Community Services – Housing, and community housing organisations about heat issues in areas with concentrations of social housing, to collaborate on mitigation and education programs	Community & Cultural Development, Sustainability
S2	Work with social service providers to identify isolated or particularly heat vulnerable members of the community and assist them to provide information to their clients on managing the impact of heat events	Community & Cultural Development, Children's Services

ACTIONS FOR MEDIUM TO LONG TERM IMPLEMENTATION

POLICY		
Ref.	Action	Responsibility
P16	Establish canopy cover targets for priority urban areas and as appropriate integrate them with city planning documents	Parks, Sustainability
P17	Review, and if necessary refine, current development controls to encourage heat mitigation in new development	City Planning
P18	Audit bus stops for shade requirements and identify priority sites for future work	Engineering Services
P19	Following P18, roll out a bus stop shade improvement program	Engineering Services
P20	Undertake an audit of key parks in the LGA to determine where shade can be better incorporated over seating etc and where drinking water fountains are required	Parks
P21	Develop, resource and implement an enhanced Street Tree Masterplan	Parks
P22	Encourage new and refurbished buildings to contribute to a landscaped, cooler and more sustainable City Centre through design including shade trees, water features, rooftop and vertical gardens (Penrith Progression 3.8)	TBA – Penrith Progression Action 3.8
P23	Explore opportunities to provide sustainable, alternative decentralised utilities to build long-term resilience (Penrith Progression 3.9)	TBA – Penrith Progression Action 3.9
P24	Create High and Station Streets as landscaped and cool ‘complete streets’ (Penrith Progression 4.6)	TBA – Penrith Progression Action 4.6
P25	Landscape and upgrade public squares, parks and spaces to ‘cool down’ the City Centre (Penrith Progression 6.1)	TBA – Penrith Progression Action 6.1
P26	Strengthen and landscape pathway links between the City’s public squares, parks and spaces (Penrith Progression 6.2)	TBA – Penrith Progression Action 6.2
P27	Improve pathways, public spaces and connections to encourage pedestrians and cyclists in the core of the City Centre (Penrith Progression 7.8)	TBA – Penrith Progression Action 7.8

COMMUNITY ENGAGEMENT

Ref.	Action	Responsibility
E8	Investigate innovative approaches to build community support and ownership of green infrastructure e.g. Adopt a street tree, Shadeways	Sustainability, Parks, Community & Cultural Development
E9	Update the community about Council's efforts to cool the City	Sustainability
E10	Engage with the community about the design of landscapes in the future	Place Management, Design & Projects, City Planning

GREEN INFRASTRUCTURE

Ref.	Action	Responsibility
G3	Landscape pathway links between the City Centres public squares, parks and spaces (Penrith Progression 6.2)	Parks, Design & Projects, Place Management
G4	Implement verge plantings in priority areas to provide shade and cooling	Parks
G5	Following G2. seek to plant identified road reserves and public spaces	Parks
G6	Implement an increase in canopy cover and shade in identified priority hotspot areas across the City	Sustainability, Parks

WATER SENSITIVE URBAN DESIGN

Ref.	Action	Responsibility
W4	Minimise impervious surfaces where practical by replacing asphalt and concrete with porous surfaces	City Works, Parks, Design & Projects

INCREASED REFLECTIVITY

Ref.	Action	Responsibility
R3	Investigate and implement trials of cool pavements throughout the City (eg car parks)	City Works

SOCIAL

Ref.	Action	Responsibility
S3	Investigate the location of potential heat refuges across the City and their proximity and availability to vulnerable populations	Community & Cultural Development



MONITORING

Council's Organisational Performance and Development (OPD) Department will be responsible for the ongoing implementation, monitoring, reporting and review of this Strategy. The team will act to support the implementation process, with more intensive support provided in the initial implementation phase before relevant actions and activities can be integrated within Council's Integrated Planning and Reporting System.

There are a number of commonly used indicators available to monitor the impact of implementation of the actions in this Strategy on various aspects of cooling the City. These types of indicators have been used by cities across the world to monitor similar actions to cool cities, and include:

- compare an updated thermal image
- monitor recorded temperature changes over time
- monitor hospital data for heat related admissions
- number of 000 calls about heat related illness over various heat wave periods
- % WSUD projects implemented
- % actions within strategy implemented
- % canopy cover / change in Landsat NDVI image
- % reflective surfaces implemented.

We will investigate ongoing reporting on these indicators to monitor the effectiveness of the implementation of this Strategy in line with Council's ongoing corporate reporting processes, including the Annual Report.

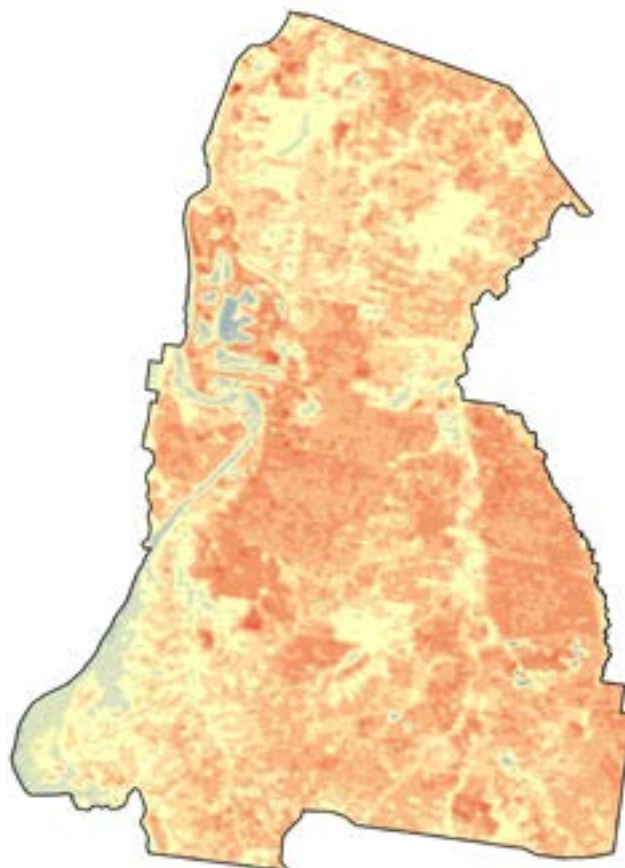
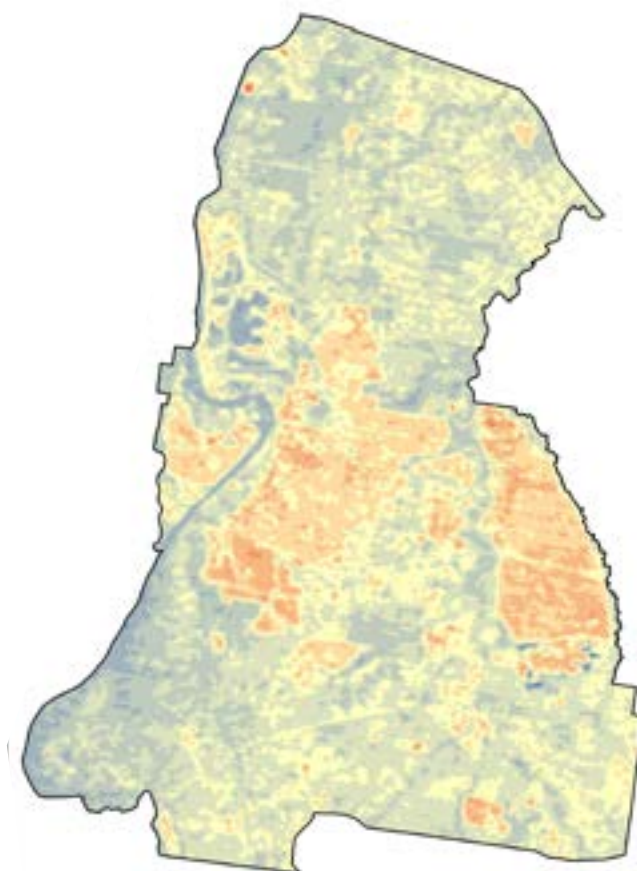
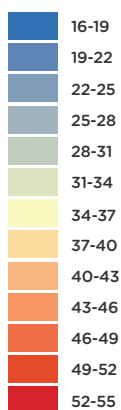
The Strategy will be reviewed prior to development of the 2021 Delivery Program to allow the outcomes to feed into Council's integrated planning processes.

APPENDIX

Landsat Derived Land Surface
Temperature Data Penrith LGA

Land surface temperature of Penrith
LGA January and February 2011.
Image processed by CSIRO using
Landsat 5TM data derived from
Geoscience Australia.

Land Surface
Temperature (°C)



RELATED PENRITH CITY COUNCIL DOCUMENTS

The Cooling the City Strategy also relates to, and must be considered in conjunction with, other Council policy and strategy documents:

- Penrith Progression: A Plan for Action 2015
- Section 94 Development Contributions Plans
- Water Sensitive Urban Design Policy 2013
- 'Our River' Nepean River Masterplan 2013
- Penrith City Centre Public Domain Masterplan 2013
- Penrith City Centre Plan Vision 2007
- Queen Street Streetscape Improvement Plan 2013
- St Marys Town Centre Strategy 2006
- Penrith Development Control Plan 2007
- Biodiversity Action Plan 2008
- Open Space Action Plan 2007
- Planning for an Ageing Community Strategy 2010
- Advocacy Program

REFERENCES

Argueso, D, Evans, J, Fita, L, Bormann, K. "Temperature response to future urbanization and climate change". Climate Dynamics Vol 42. April 2014

Bureau of Meteorology "Sydney in 2014: a very warm, dry year" Jan 2015. www.bom.gov.au/climate/current/annual/nsw/sydney.shtml

Barnett, G, Beaty, RM, Chen, D, McFallan, S, Meyers, J, Nguyen, M, Ren, Z, Spinks, A & Wang, X 2013, Pathways to climate adapted and healthy low income housing National Climate Adaptation Research Facility, Gold Coast, 95 pp. http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Barnett_2013_Climate_adapted_low_income_housing.pdf

Caffin, M. 'Penrith City Council Hotspots Study' July 2014

City of Melbourne "Urban Forest Strategy 2012-2032"

City of Sydney Council "Greening Sydney Plan", May 2012

Climate Sensitive Urban Design and urban land surface-atmosphere interactions, Coutts et al. 2013

Greening Australia, "The Urban Heat Island Effect and Western Sydney"

"Greencover Demonstration Project Liverpool City Centre and Penrith" NSW Public Works Government's Architects Office December 2011. https://www.publicworks.nsw.gov.au/sites/default/files/pdf/Greencover_Report_Intro.pdf

Greening the West, "Greening the West – a regional approach. Strategic Plan". http://healthyurbanhabitat.com.au/wp-content/uploads/2013/11/GTW_Strategic_Plan_web.pdf

Hewitt & Mackres "Cool Policies for Cool Cities: best practices for mitigating urban heat islands in North American Cities" American Council for an Energy Efficient Economy and Global Cool Cities Alliance. June 2014

Jacobs B and Delaney C (2015) "Adapting to Urban Heat: Penrith City Council." Prepared for Penrith City Council by the Institute for Sustainable Futures, University of Technology Sydney.

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

NSW Government, "Heatwave Subplan – A subplan of the NSW Disaster Plan", November 2011.

Nairn, J. and Fawcett, R. "Defining Heatwaves". The Centre for Australian Weather and Climate Research. March 2013. http://www.cawcr.gov.au/publications/technicalreports/CTR_060.pdf

Nicholls, N, et al. "A simple heat alert system for Melbourne, Australia." International Journal of Biometeorology; 2008.

North Sydney Council "Urban Forest Strategy" 2011

NSW Office of Environment and Heritage "Metropolitan Sydney Climate Change Snapshot" 2014

NSW Government Health "Beat the Heat". www.health.nsw.gov.au/environment/beattheheat/pages/people-most-at-risk.aspx

Norton. B, Coutts. A, Livesley. S, Williams. N. "Decision principles for the placement of Green Infrastructure" Victorian Centre for Climate Change Adaptation Research March 2013

Norton. B et al "Planning for a cooler future: green infrastructure to reduce urban heat" Victorian Centre for Climate Change Adaptation Research, October 2013.

Pricewaterhouse Coopers 2011, "Protecting human health and safety during severe and extreme events: a national framework", PWC, Sydney.

Penrith City Council Community Plan 2013

Reducing Urban Heat Islands Compendium of Strategies: Heat Island Reduction Activities. <http://www.epa.gov/heatisland/resources/pdf/ActivitiesCompendium.pdf>

Steffan, W. "The Angry Summer" 2013. Climate Commission Secretariat.

The impacts of WSUD solutions on human thermal comfort. Green Cities and Micro-climate B3.1-2-2014

The Conversation "Smart Urban Design Could Save Lives in Future Heatwaves", 2014. <http://theconversation.com/smart-urban-design-could-save-lives-in-future-heatwaves-33246>

Victorian Centre for Climate Change Adaptation Research (2013) Final Report Responding to the Urban Heat Island: A Policy and Institutional Analysis

Where are all the trees? An analysis of tree canopy cover in urban Australia. 20:20:20 Vision 2014

Water Sensitive Urban Design Policy, Penrith City Council 2014

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