Adapting to urban heat events: by mapping vulnerability hot spots

COUNCIL NAME
Penrith City Council and Leichhardt Council

WEB ADDRESS
penrithcity.nsw.gov.au
leichhardt.nsw.gov.au

SIZE
415 square kilometres (combined)

POPULATION
247,700 (combined)

Overview

An urban heat study was conducted for the Penrith and Leichhardt local government areas analysing surface temperature, vegetation and social vulnerability. It served to determine opportunities to adapt local hot spots in terms of infrastructure provision and behavioural change. Subsequently, strategies addressing urban heat were developed and adopted for both councils; specific to the different requirements in the Inner West and Greater Western Sydney.

Background

Heatwaves are a significant hazard in Australia for people and the environment. They have been responsible for more human deaths than any other natural hazard, including bushfires, storms, tropical cyclones and floods. As a result of climate change, the Metropolitan Sydney Region is expected to experience heatwaves that occur more often and last longer than currently. The greatest increase is projected for Western Sydney and the Hawkesbury with 5 – 10 additional hot days by 2030 (OEH, 2015).

Temperature is also influenced in urban areas by the urban heat island (UHI) effect. Cities create their own microclimates by influencing the surrounding atmosphere and interacting with climate processes. The UHI effect represents higher air temperatures in urban areas than those in surrounding non-urban areas (Taha 1997). In Sydney, morning summer surface temperatures in treeless urban areas are on average 12.8°C higher than vegetated non-urban areas (Adams & Smith 2014).

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.

Implementation

Having identified heat and hot days as key risks to services and operation in their respective climate change risk assessments, Penrith and Leichhardt councils teamed up with the Institute of Sustainable Futures (ISF) to undertake the hot spot mapping and analysis to better identify and treat localised urban heat risks. The most severe urban heat islands in the two council areas were identified through aerial imagery and mapping of surface temperature (using Landsat data), vegetation and tree canopy cover, and selected infrastructure used by the community such as bus stops. This spatial analysis provided a heat analysis for selected suburbs in the Penrith and Leichardt areas and highlighted regions of high vulnerability.

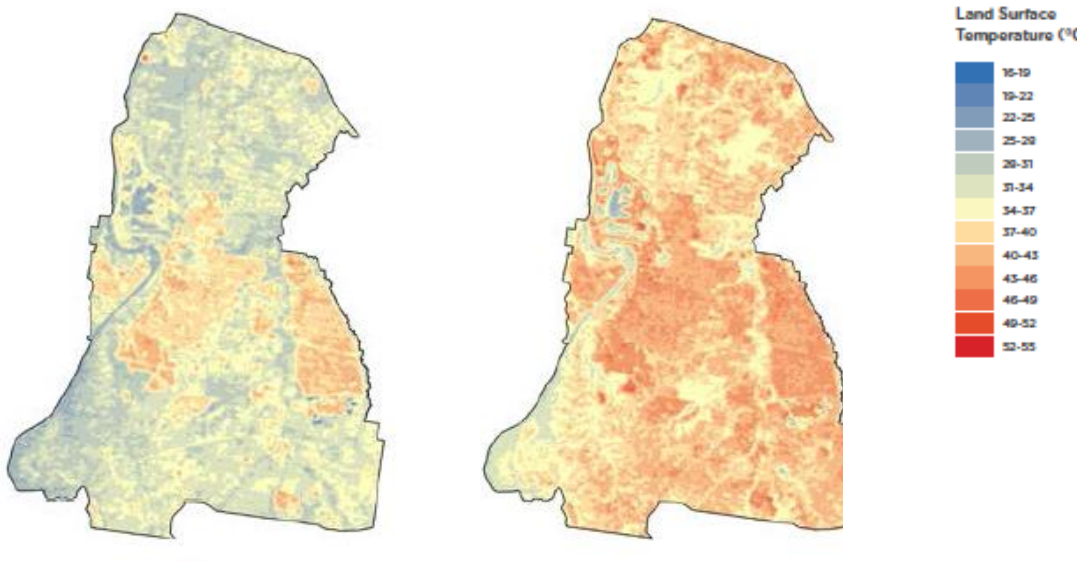
Across both council areas, residential and commercial areas emerged as priority zones due to the presence of localised heat islands combined with relatively high levels of public exposure. To understand the biophysical environment in ‘hotspots’, the land surface composition was quantified to gauge the proportion of tree cover, sealed surfaces, grass etc. using iTree canopy.

The results of this analysis were then ‘ground-truthed’ through on-site assessment of the residential and commercial hotspots to confirm the land cover proportions and better understand the urban design characteristics that may be driving urban heat.

Semi-structured interviews with local community service providers were undertaken to investigate the specific risks facing vulnerable groups in residential areas and the strategies these service providers have adopted to cope with heat wave conditions.

The researchers also interviewed relevant council staff in the community services and planning sections. Subsequent discussions between the environment, transport, roads, community services teams occurred to assess the risk and develop treatments.

The project was able to assess the potential risks based on the co-location of heat, vulnerable community groups and presumed community movements.



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

Outcomes

Urban heat was revealed to be a common occurrence across the suburbs in this study. However, it was also observed that heat was unevenly distributed across each suburb. Hotspots generally appeared in areas which had high proportions of sealed surfaces (roads, footpaths, roofs etc.) and much lower proportions of tree and grassed surfaces. This imbalance in the land surface cover was more pronounced in the commercial areas, with sealed surfaces found to be covering up to 90% of the surface in hotspots.

Reserves, recreational areas, surface water and riparian zones were visibly cooler regions across all suburbs, and could be up to 8^{o}C cooler than the ambient temperature. There were also stark differences in surface temperature between the cooler peri-urban areas and the hotter areas of dense residential development.

REFERENCES

NSW Office of Environment and Heritage (2015) *Urban Heat Climate Change Impact Snapshot*

Taha, H 1997, 'Urban climates and heat islands: albedo, evapotranspiration, and anthropogenic heat', *Energy and Buildings* 25, 99–103, doi-10.1016/S0378-7788(96)00999-1.

Adams, M & Smith, P 2014, 'A systematic approach to model the influence of the type and density of vegetation cover on urban heat using remote sensing', *Landscape and Urban Planning* 132, 47–54.

Institute of Sustainable Futures (2015) *Adapting to Urban Heat: Leichhardt Council*

While the site-specific causes of heat can include the level of tree cover, water absorption and the surface albedo value (solar reflectivity); the geometry of urban areas, topography and wind direction are also influential. In spite of this complexity, this study has shown that the presence of tree cover explains 55% of the variation in surface temperature in 16 Penrith hotspots. This finding provides clear evidence of the need to support tree planting in hotspots throughout the local government area.

This project informed the development of Penrith City Council's "Cooling the City" Strategy which was endorsed by Penrith City Council on 10 August 2015. Leichhardt Council has also endorsed the research and adopted a number of management actions at its Policy Council Meeting on 8 March 2016. Recommendations to adaptively address and minimise risks to local communities from urban heat, cover a range of areas including:

- State and industry partnerships
- Policy development
- Maximising existing cooling features in the landscape
- Identification of priority areas
- Applying heat reduction principles to new and existing development
- Maximising the cooling space of the local environment
- Working closely with the community especially vulnerable groups.

Key Learnings

While remote sensing offers more detail due to its high resolution, the costs associated with aerial photography data collection meant it was not financially feasible for this project. Utilising existing Landsat Data imagery, provided by CSIRO for free under license and with agreement, was a cost-effective and useful way to present the distribution and intensity of heat islands. However, for some studies that seek to model the impacts of surface properties (such as the albedo of specific buildings and their corresponding energy costs) on urban heat, a remote sensing approach may be more appropriate (ISF, 2015).

For this study, the benefits of satellite heat imagery outweighed the limitations of the data because it provided a feasible way of tracking urban heat, evaluating implementation programs and responding to emerging problems (ISF, 2015).

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NSW Environmental TRUST

This project has been assisted by the NSW Government through its Environmental Trust