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HeatWatch

Extreme heat in Western Sydney

Increasing extreme heat will have profound impacts on people, industries and ecosystems in Western Sydney. CSIRO and Bureau of Meteorology projections estimate that the average number of days over 35 could increase by up to five times without strong climate policies from a historical average of 11 up to 52 days by 2090. Some parts of Western Sydney will experience even more extreme heat days.

Mark Ogge
Bill Browne
Travis Hughes
November 2018

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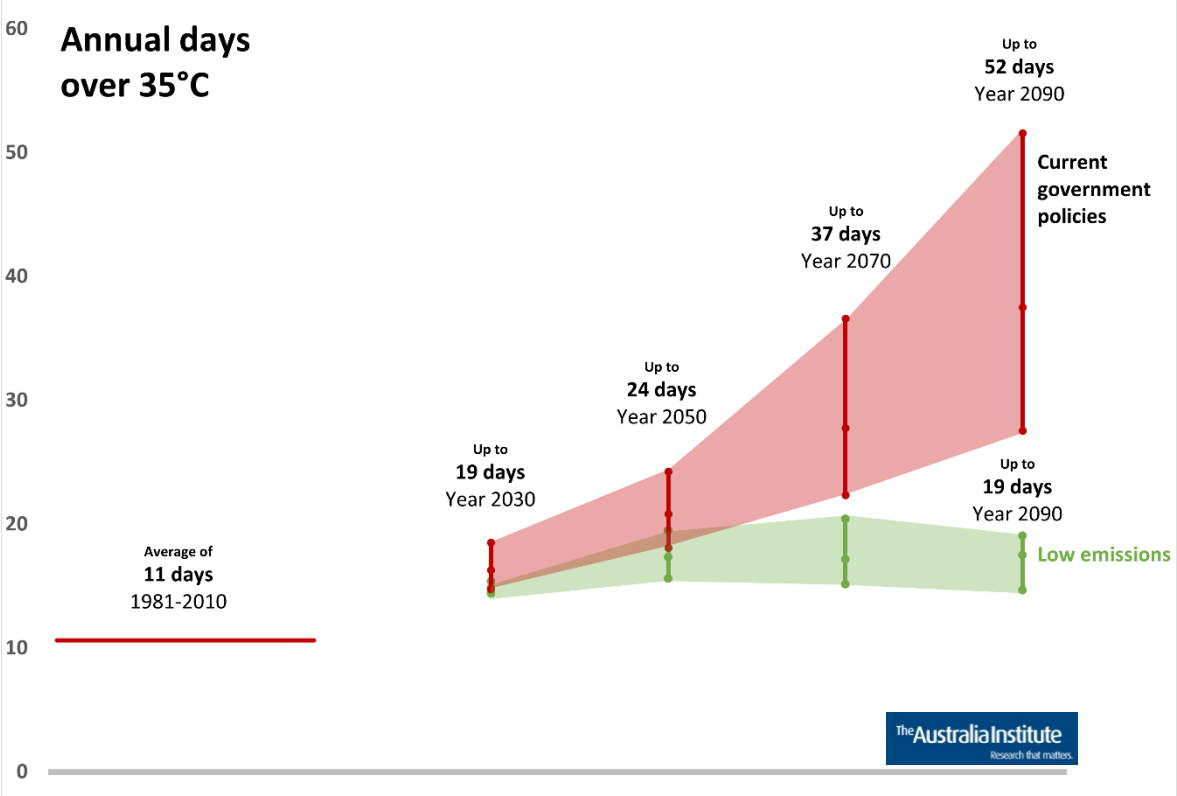
Summary

The projected rise in extremely hot days because of global warming presents a serious risk to the health and wellbeing of the Western Sydney community. Due to its geography and built environment, Western Sydney already experiences temperatures 6–10 degrees higher than Eastern Sydney during extreme heat events.

At temperatures above 35 degrees, the human body's ability to cool itself reduces, making it a common benchmark temperature for occupational health and safety experts, academic and government researchers.

The number of days per year over 35 degrees in Western Sydney has increased from an average of 9.5 days per year in the 1970s to 15.4 days per year in the last decade. By 2090, days over 35 degrees could more than triple to a projected 52 days, as shown in Figure 1 below:

Figure 1: Forecast annual number of days over 35 degrees Western Sydney



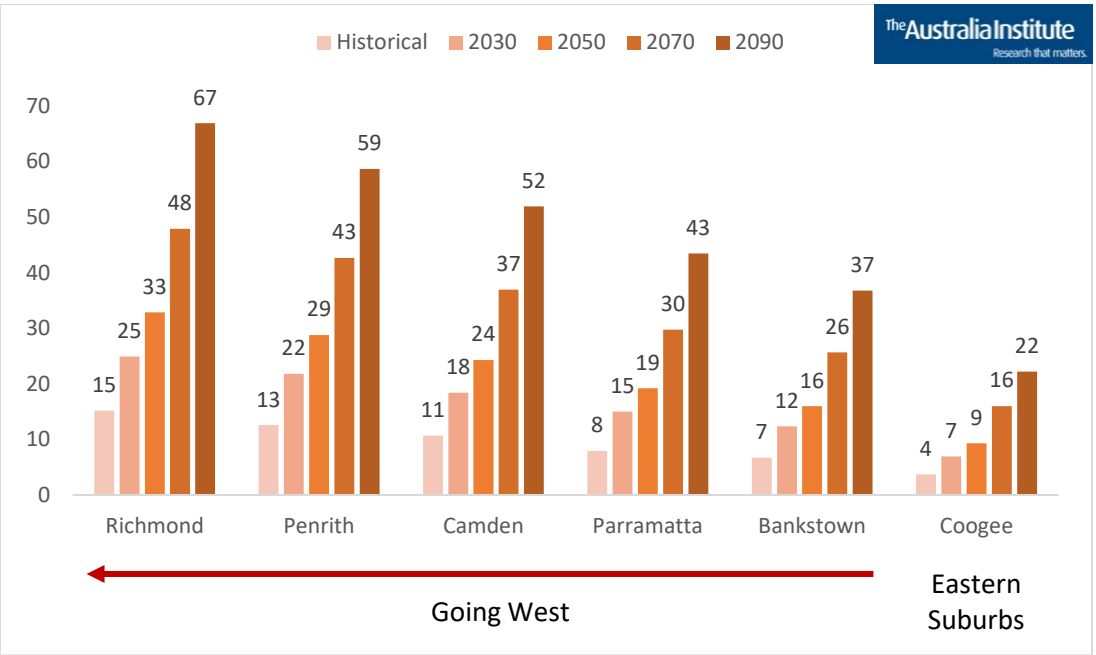
Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Parts of Western Sydney, such as Richmond, will experience even more extreme heat days: up to 67 per year by 2090. CSIRO and the Bureau of Meteorology (BoM) project that across Western Sydney between a quarter and a third of summer days will be over 35 degrees by 2090.

The data also predicts large increases in days over 40 degrees, from Western Sydney's historical average of 1 day over 40 degrees per year up to 12 days over 40 degrees per year by 2090. Some parts of Western Sydney will experience even more extreme heat days, including Richmond with up to 17 days per year over 40 degrees by 2090.

Climate change will not affect everyone equally. People in Western Sydney will endure more hot days than people in other parts of the state, as shown in Figure 2 below:

Figure 2: Days over 35 degrees in selected locations (current policies scenario)



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Extreme heat events also present a risk to critical infrastructure including road, rail and electricity generation. In the densely urbanised environment of Western Sydney, power failure alone can lead to serious health risks with many homes and workplaces reliant on air-conditioning to maintain safe temperatures. Extreme temperatures also pose a risk to the health and safety of workers in many industries and has a major impact on productivity and economic activity.

Fortunately, if emissions are reduced the rises in extreme heat days will be far lower. As shown in Figure 1 above, with a decisive reduction in emissions the number of 35 degree days could be kept to 19 days per year by 2090, around a third as many days as are expected under a business-as-usual scenario.

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Introduction

As the climate warms, the number of extremely hot days is increasing. The average number of days over 35 degrees in Western Sydney (which we define further down) has increased considerably in recent years and is forecast to increase at a higher rate without a strong action on climate change.

In January 2018, Western Sydney experienced the highest temperatures recorded in 79 years, with Penrith reaching 47.3 degrees – making it the hottest place in the world that day.[1] Total fire bans, severe fire danger warnings and extreme heatwave forecasts were issued for the region,[2] air quality was poor and ozone levels exceeded the national air quality standards – which can have serious health effects for those with asthma.[3] NSW Police warned residents not to do strenuous or sporting activity.[4]

Penrith had already experienced its highest December temperature on record the month before, during a previous heat wave.[5]

EXTREME HEAT

Extreme heat is dangerous for human health, for ecosystems and agriculture. At temperatures above 35 degrees, the human body's main cooling mechanism – sweating – is far less effective. Sweating exchanges heat from the body to the atmosphere, but this heat exchange process diminishes significantly beyond 35

[1] Morris (2018) *Yesterday Sydney was the hottest place on Earth,* https://www.nationalgeographic.com.au/australia/yesterday-sydney-was-the-hottest-place-on-earth.aspx

[2] ABC News (2018) *Sydney hits its highest temperature recorded since 1939 with Penrith reaching 47.3C,* http://www.abc.net.au/news/2018-01-07/sydney-hits-its-highest-temperature-recorded-in-79-years/9309552

[3] McInnes (2018) *Health warnings issued as Sydney faces heatwave,* https://www.canberratimes.com.au/national/nsw/health-warnings-issued-as-sydney-faces-heatwave-20180106-h0ecky.html

[4] McInnes (2018) *Health warnings issued as Sydney faces heatwave,* https://www.canberratimes.com.au/national/nsw/health-warnings-issued-as-sydney-faces-heatwave-20180106-h0ecky.html

[5] ABC News (2017) *Western Sydney sweated through new record high 15C hotter than city's beaches,* http://www.abc.net.au/news/2017-12-19/nsw-hot-weather-boils-with-penrith-record/9273888

degrees and body temperature rises. This creates discomfort and a range of health impacts, from mild to severe, and can ultimately be fatal without intervention.[6]

Because of this, many regulators and researchers use 35 degrees as an important threshold for safety, work and climatic conditions. 35 degrees is seen as the "limit of high temperature tolerance" by the Occupational Health and Safety Representatives of the Victorian Trades Hall Council; academic researchers have pointed to this as a point where substantial productivity is lost. The CSIRO and Bureau of Meteorology publish 35-degree threshold predictions.[7]

A future of such extreme heat days represents a serious threat to the wellbeing of Western Sydney and Australia's wider population. As well as an increase in heat related deaths and illness, the rise in extreme heat increases irritability and psychological stress.[8] Hot weather affects patterns in domestic violence,[9] interrupts sleep patterns and reduces capacity and willingness to exercise. All carry broad ramifications, such as increased accident risk, sedentary life style-induced diabetes and cardio vascular disease.[10] Tracking and minimising the way climate change is affecting the number of hot days is of direct interest to the wellbeing of local communities, particularly in very hot areas such as Western Sydney.

WESTERN SYDNEY

To give a full picture of changing historical temperatures as well as anticipated temperature increases in the future, this report looks at historic temperature data collected by the Bureau of Meteorology from five Western Sydney sites:

[6] Hanna and Tait (2015) *Limitations to thermoregulation and acclimatisation challenges human adaptation to global warming,* Int J Environ Res Public Health, https://academic.oup.com/heapro/article/30/2/239/561863

[7] Victorian Trades Hall Council (2018) *Heat*, http://www.ohsrep.org.au/hazards/workplace-conditions/heat; Singh et al (2015) Working in Australia's heat: health promotion concerns for health and productivity, Health Promotion International, https://academic.oup.com/heapro/article/30/2/239/561863; CSIRO and BoM (2015) *Climate change in Australia: Projections for Australia's NRM Regions*, https://www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/

[8] Queensland Health (2015) *Heatwave Response Plan* https://www.health.qld.gov.au/__data/assets/pdf_file/0032/628268/heatwave-response-plan.pdf

[9] Auliciems and Di Bartolo (1995) *Domestic Violence in a subtropical environment: police calls and weather in Brisbane.* International Journal of Biometeorology 39 (1).

[10] Kjellstrom T et al (2009) *The Direct Impact of Climate Change on Regional Labor Productivity.* Archives of Environmental & Occupational Health 64 (4); World Health Organisation (2017) *Preventing noncommunicable diseases (NCDs) by reducing environmental risk factors*, http://apps.who.int/iris/bitstream/10665/258796/1/WHO-FWC-EPE-17.01-eng.pdf?ua=1

- Richmond RAAF Base
- Camden Airport
- Bankstown Airport
- North Parramatta (Masons Drive)
- Penrith Lakes

It also looks at CSIRO–BoM temperature projections for five suburbs in Western Sydney:

- Richmond
- Penrith
- Parramatta
- Bankstown
- Camden

The CSIRO–BoM data is a time series from the Australian Water Availability Project (AWAP) where the average temperature was compiled in five kilometre by five kilometre spatial grids between 1981 and 2010.[11] This time series uses between five and eight models to predict days over 35 degrees, over 37 degrees and over 40 degrees in 2030, 2050, 2070 and 2090.[12] It also has a historical average for the years 1981–2010.

The report also employs the IPCC scenarios for global climate action: RCP 2.6 ("low emissions"), RCP 4.5 ("intermediate emissions") and RCP 8.5 ("high emissions/current government policies"). RCP 2.6 equates roughly to what is required to keep the world below 1.5 degrees warming, RCP 4.5 to what is required to keep the world below 2 degrees warming, and RCP 8.5 is the "business as usual" scenario where the world fails to act decisively on climate change. RCP 8.5 is the current trajectory due to the world's failure to implement necessary climate policies.

The results of the different models are reduced to three sets for each of the three scenarios:

- a minimum result (the result from the model with the fewest hot days predicted)
- a maximum result (the result from the model with the most hot days predicted)

[11] CSIRO and Bureau of Meteorology (2015) *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*, CSIRO and Bureau of Meteorology.

[12] All eight models – ACCESS1.0, CESM1-CAM5, CNRM-CM5, GFDL-ESM2M, HadGEM2-CC, CanESM2, MIROC5 and NorESM1-M – are available for the RCP 4.5 and RCP 8.5 scenarios. Five models – CESM1-CAM5, CNRM-CM5, CanESM2, MIROC5 and NorESM1-M – are available for the RCP 2.6 scenario.

- a mean result (the average result across all models).

The results across the five sites are also averaged to give an overall Western Sydney result.

There is also more limited data for the number of summer days over 35, 37 or 40 degrees, which is also used where available.

There is no universally approved definition of Western Sydney. In this report, we use climate data from Camden, Bankstown, Parramatta, Richmond and Penrith to create a picture of what Western Sydney can expect from climate change – particularly in contrast to central Sydney (Observatory Hill) and the Eastern Suburbs (for which the report centres on Coogee).[13]

ABOUT HEATWATCH

The Australia Institute's HeatWatch initiative puts current Australian research about temperature increases due to global warming into context, using data from the Bureau of Meteorology and the CSIRO.

Global temperature increases of 1.5 or 2 degrees above pre-industrial levels will have dramatic impacts on human health, the ecosystem and the economy. The IPCC has found that human-induced warming reached 1 degree above pre-industrial levels in 2017.[14]

Current policy settings would see more extreme warming than 2 degrees above pre-industrial levels. However, temperatures fluctuate by much more than a few degrees every day, meaning that the compounding and extreme effects of temperature increases can be difficult to imagine.

HeatWatch uses extreme heat days (days over 35 degrees) along with other thresholds like 37 degrees and 40 degrees to highlight that the effects of global warming will

[13] Some definitions of Western Sydney would include Canterbury or parts of the Blue Mountains. The Western Sydney University includes Springwood but appears to exclude Canterbury from its Greater Western Sydney region map: https://www.westernsydney.edu.au/rcegws/rcegws/About/about_greater_western_sydney; the City of Canterbury–Bankstown withdrew from the Western Sydney Regional Organisation of Councils in 2016: Saulwick (2016) *If Bankstown is no longer western Sydney, where do you draw the line?* https://www.theage.com.au/national/nsw/if-bankstown-is-no-longer-western-sydney-where-do-you-draw-the-line-20161208-gt6e38.html

[14] IPCC (2018) *Global Warming of 1.5 °C,* p 1:4, https://www.ipcc.ch/report/sr15/

include a dramatic increase in days where it is uncomfortable or dangerous to operate outside – affecting industries like construction, sport and other outdoor activities.

HeatWatch began with *Cooked with gas: Extreme heat in Darwin,* which highlighted that the Northern Territory's plans to exploit emission-intensive oil and gas reserves will contribute to global warming which could increase the number of days over 35 degrees in Darwin from the current rate of 22 per year to 275 per year in 2070.[15]

Other HeatWatch reports have covered extreme heat in Rockhampton, Gladstone, Roma, the Sunshine Coast and the Gold Coast. The last three reports were presented alongside Queensland Fire and Emergency Services workshops on extreme heat.

The Australia Institute will continue to focus on additional locations and welcomes interest to collaborate on local versions of the reports.

All HeatWatch reports are available on our website: http://www.tai.org.au/heatwatch

[15] Hanna and Ogge (2018) Cooked with gas: Extreme heat in Darwin, http://www.tai.org.au/content/cooked-gas-extreme-heat-darwin

Hot days in Western Sydney

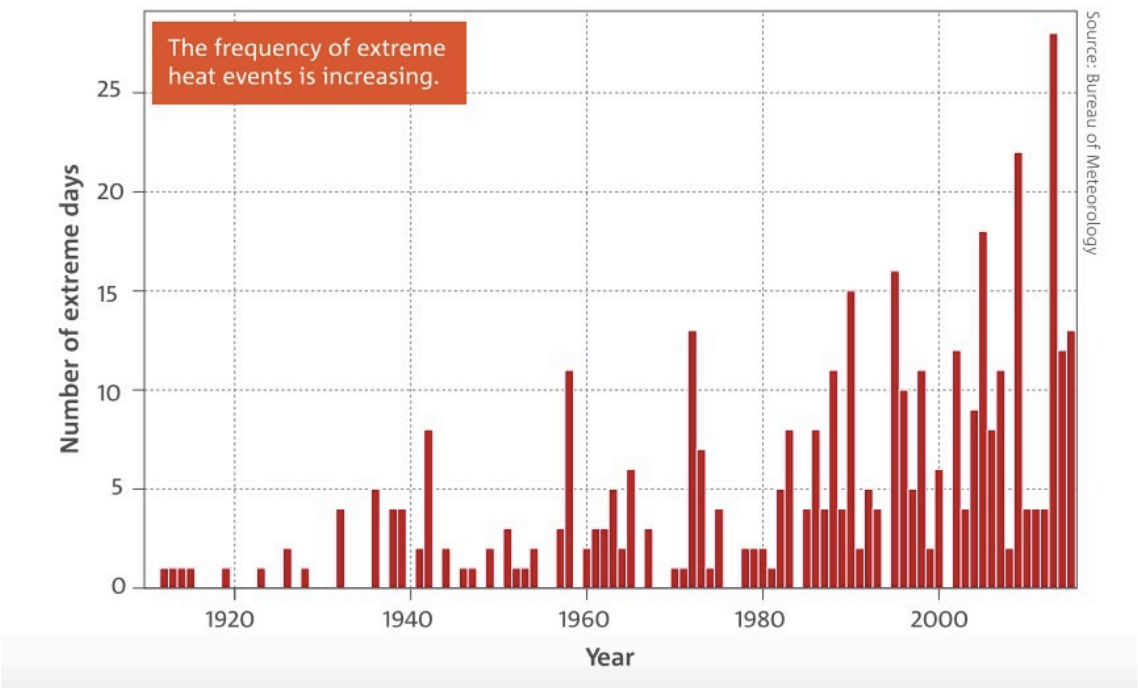
In Australia and globally there has been a clear trend of increasing temperatures and extreme heat events that are attributable to global warming.

The increase in extreme heat events across Australia as a whole is shown in Figure 3 below. This Bureau of Meteorology graph shows the annual number of days exceeding the 99th percentile of each month from 1910–2015.

The Bureau of Meteorology attributes this trend to global warming:

> As the global climate system has warmed, changes have occurred to both the frequency and severity of extreme weather. In Australia, the most obvious change has been an increase in the occurrence of record-breaking heat.[16]

Figure 3: Frequency of extreme heat days, Australia.



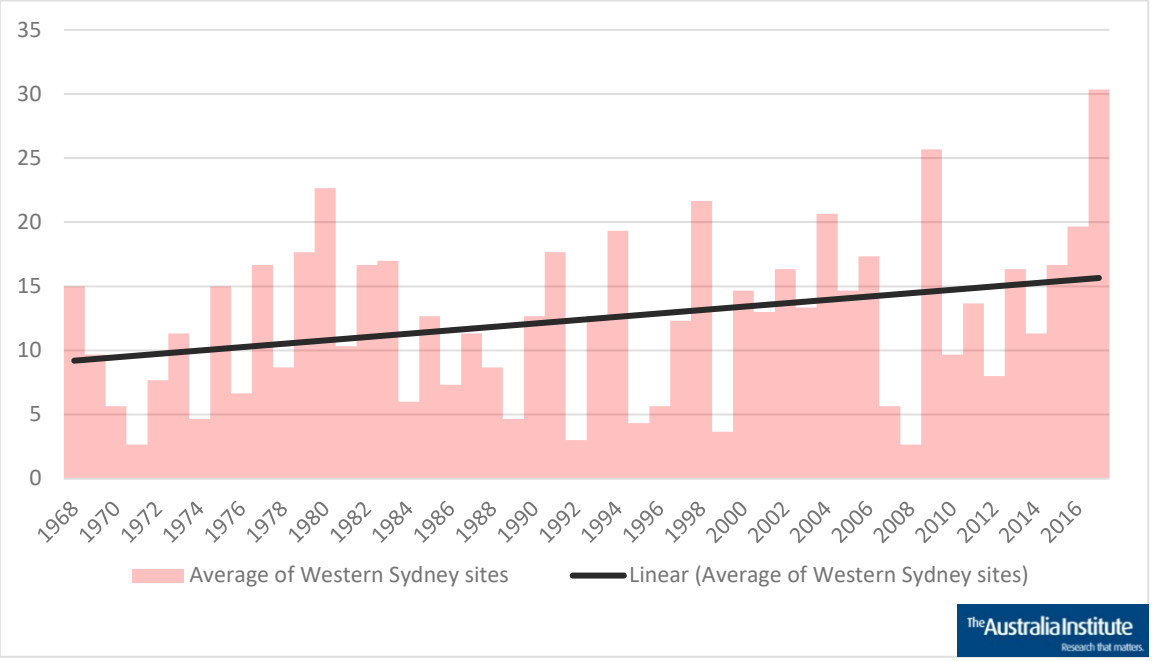
Source: BoM (2016) *State of the Climate*

[16] BoM (2016) *State of the Climate,* http://www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2016.pdf

The Bureau of Meteorology has long-term temperature records for three sites in Western Sydney: Richmond (since 1881, at what is now UWS Hawkesbury), Bankstown (since 1968, at Bankstown Airport) and North Parramatta (since 1965, at Masons Drive).[17] It also has long-term temperature records for Camden (since 1972, at Camden Airport), but a period of several years in the 1990s where observations were not made at Camden means its inclusion in the average would distort that decade's figures.

Figure 4 below shows the average number of days over 35 degrees in each year from 1968 onwards across the three sites.[18]

Figure 4: Annual number of days over 35 degrees Western Sydney, 1968–2017



Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Figure 4 shows that the trend of days over 35 degrees in Western Sydney has increased significantly over the last 50 years. Despite droughts and heatwaves in the late 1970s and early 1980s and the Millennium Drought of the early 2000s, the past ten years have the highest number of hot days recorded.

[17] Since 1993, observations have also taken place at Richmond RAAF and, since 1995, at Penrith Lakes and Canterbury. These have been excluded from the Western Sydney averages because of their short duration and, for Canterbury, because of debate over whether it is Western or South Sydney.

[18] While observations began earlier at each site, 1968 is the earliest year in which two of the three sites were consistently recording temperatures; the third site, Bankstown, was consistently recording from 1969. Starting from 1968 allows us to neatly report averages for the five decades 1968–2017.

There is a clear increase in numbers of extreme heat days over the recorded period as summarised in Table 1 below:

Table 1: Average days per year above 35, 37 or 40 degrees, Western Sydney

Decade	Over 35 degrees	Over 37 degrees	Over 40 degrees
1968–1977	9.5	4.8	1.3
1978–1987	13.0	7.4	1.9
1988–1997	10.1	4.7	1.2
1998–2007	14.1	7.6	2
2008–2017	15.4	8.6	3.1
Average 1968–2017	*12.4*	*6.6*	*1.9*

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Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

As shown in Table 1 above, the last decade has averaged 15.4 days over 35 degrees. This represents an increase of 50% since the 1970s. More worrying still, the following decades are likely to exacerbate these challenges.

Projected increases in days over 35 degrees

The number of days over 35 degrees in Western Sydney is expected to increase in the coming decades according to CSIRO and BoM climate modelling.

The CSIRO use eight climate models to project temperature extremes into the future. All climate models use different methods for understanding the complex climate system, and as such provide a range of projections. The models used by the CSIRO are selected based on how well they simulate the current climate.[19]

Our analyses in the figures below use all climate models selected by the CSIRO, and present the full range of their projected increases in days over the various temperature thresholds according to two different emissions scenarios. These figures also mark the average of the projections, as well as the highest and lowest ones.

The two scenarios the projections are based on are from the United Nations Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways (RCPs), which are two of four scenarios of various levels of concentrations of greenhouse gases in the atmosphere.

The historical data used to make projections by the CSIRO–BoM models is not the year-by-year date from the "Hot days in Western Sydney" chapter, but is instead a time-series from the Australian Water Availability Project (AWAP) where the average temperature was compiled in 5x5km spatial grids between 1981 and 2010.[20] These models, and the projections built off them, observed 11 days a year over 35 degrees historically, which is similar to the average since 1968 of 12.4 days at the three long-operating recording stations in Western Sydney.

Based on the five suburbs in Western Sydney we considered, in a current government policies scenario on emissions (both local and global), the average number of hot days would go from a historical 10.6 (between 1981 and 2010) to 27.6–51.6. In other words,

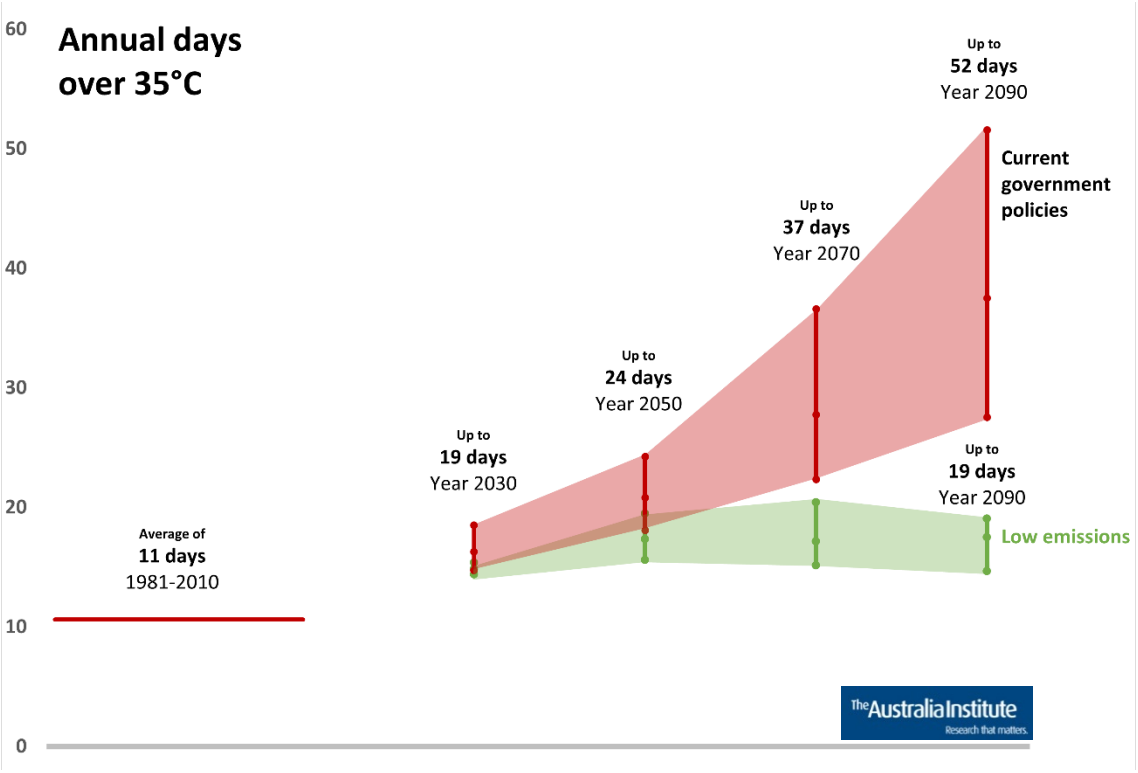
[19] CSIRO (n.d.) *Modelling choices and methodology,* Climate Change in Australia, https://www.climatechangeinaustralia.gov.au/en/climate-projections/about/modelling-choices-and-methodology/

[20] CSIRO and Bureau of Meteorology (2015) *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*, CSIRO and Bureau of Meteorology.

the number of hot days would triple, quadruple or increase to five times their historical level.

The Figure 5 below shows CSIRO predictions to 2090 of the two scenarios:

Figure 5: Forecast annual number of days over 35 degrees Western Sydney



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Figure 5 displays the scenario 'RCP 8.5', which is the highest of the four scenarios of global emissions outlined by the IPCC in their 2014 Fifth Assessment. It reflects the current government policies scenario, which most closely resembles the current global trajectory as emissions continue to increase and little action is taken.[21]

Under the current policies scenario of greenhouse emissions, the CSIRO projects that Western Sydney could experience as many as 19 days over 35 degrees per year in 2030, and 52 days per year by 2090. This would be a fivefold increase from the historical average of 11 days from 1981–2010. The range of the eight climate model projections under current policies is shaded in red.

Figure 5 also shows the projected number of days over 35 degrees under the RCP 2.6 scenario where dramatic emission reduction is achieved. The RCP 2.6 pathways keep

[21] Le Quere et al (2017) *Global carbon budget 2017,* Earth Syst Sci Data 8.

warming below 1.5 degrees Celsius, which the IPCC described as necessary to "prevent dangerous anthropogenic interference with the climate system".[22] If this is achieved, the average of the CSIRO climate models expects the number of days over 35 degrees per year to be lower than in a current policies trajectory – with 15 days over 35 degrees per year in 2030, 20 days per year in 2050, 20 days per year in 2070, and 19 days per year in 2090. While these figures carry significant inherent risk, substantial additional harm could be avoided. The range of the five climate model projections that assume a substantial reduction in emissions is shaded in green.

Table 2 below presents the same data as in Figure 5 with an additional intermediate scenario, based on RCP 4.5 as modelled by the IPCC.

Table 2: Western Sydney days over 35 degrees

Scenario	1981–2010	2030	2050	2070	2090
Historical	10.6				
Low emissions		14.4-15.4	15.6-19.5	15.2-20.4	14.7-19.1
Intermediate emissions		14.2-16.9	15.8-21.4	17.2-24.2	18.4-25.3
Current policies		14.7-18.5	18.1-24.2	22.3-36.6	27.6-51.6

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Note: The range is between the average of the lowest results for each suburb and the average of the highest results for each site.

[22] Shine (2018) *IPCC 1.5 degree report: Here's what the climate science says,* https://theconversation.com/ipcc-1-5-report-heres-what-the-climate-science-says-104592

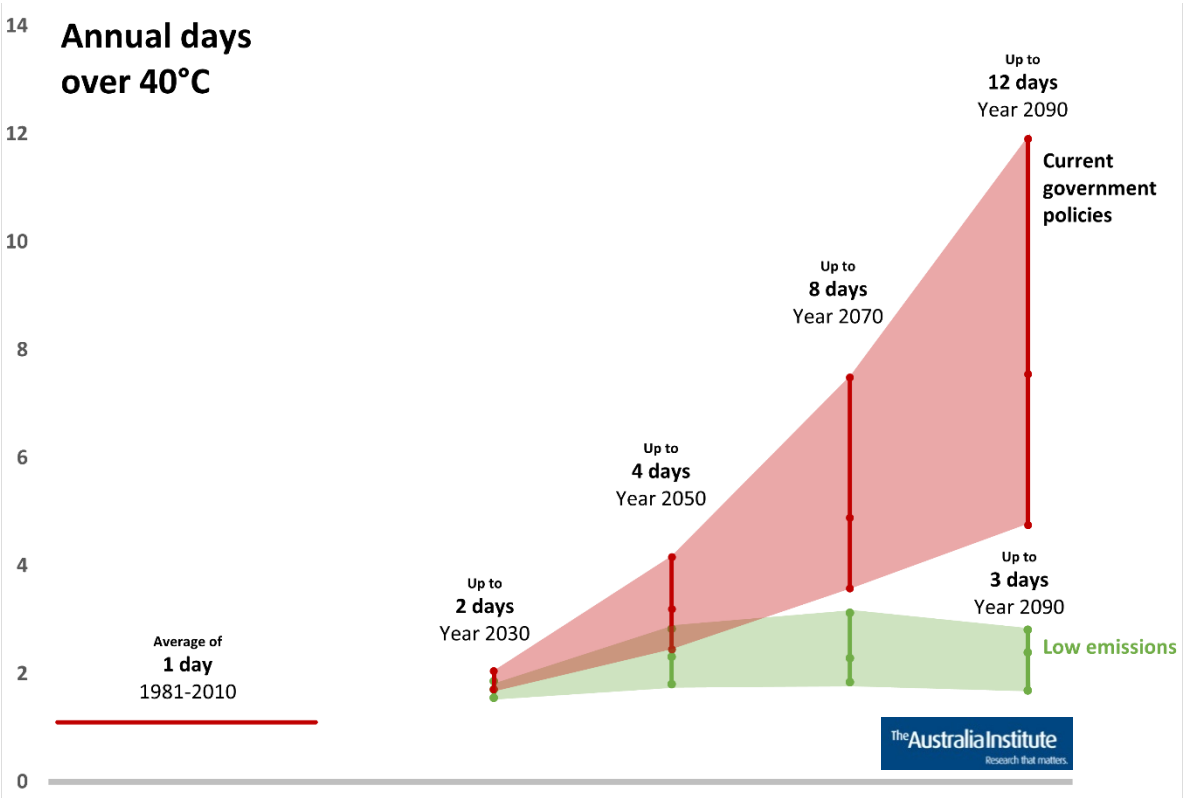
Projected increases in days over 40 degrees

Also concerning for Western Sydney is the historical and projected increase in days over 40 degrees during the same timeframe. The number of days over 40 degrees in Western Sydney is expected to increase dramatically in the coming decades according to the eight models used by the CSIRO and BoM climate models.

Under a scenario modelling current government policies on greenhouse emissions, the CSIRO projects that Western Sydney could experience 2 days over 40 degrees per year in 2030, and up to 12 days per year by 2090: twelve times the historical average of 1 day per year from 1981 to 2011.

Figure 6 below lays out the CSIRO predictions out to 2090 under the current policies and the low emissions RCP 2.6 scenario that includes a dramatic reduction in emissions.

Figure 6: Forecast annual number of days over 40 degrees Western Sydney



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Figure 6 displays the range of the eight climate model projections under current policies shaded in red. The range of the five climate model projections with the low emissions scenario (policies to keep warming below 1.5 degrees) is shaded in green.

In the RCP 2.6 scenario, the average of the CSIRO climate models expects the number of days over 40 degrees per year to be significantly lower than in the current policies trajectory – with 2 days over 40 degrees per year in 2030, 2 days per year in 2050, 3 days per year in 2070, and 3 days per year in 2090. While that many extreme heat days still carries significant inherent risk, they represent a situation of much reduced harm compared to the current policies scenario with many more extreme heat days.

Western Sydney's historical average is one day a year over 40 degrees. Table 3 below presents the same data as in Figure 6 with an additional intermediate scenario, based on RCP 4.5 as modelled by the IPCC.

Table 3: Western Sydney days over 40 degrees

	1981-2010	2030	2050	2070	2090
Historical	1.1				
Low emissions		1.6-1.9	1.8-2.8	1.8-3.1	1.7-2.8
Intermediate emissions		1.5-2.3	1.9-3.4	2.1-4.0	2.6-4.4
Current policies		1.7-2.1	2.5-4.2	3.6-7.5	4.8-11.9

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

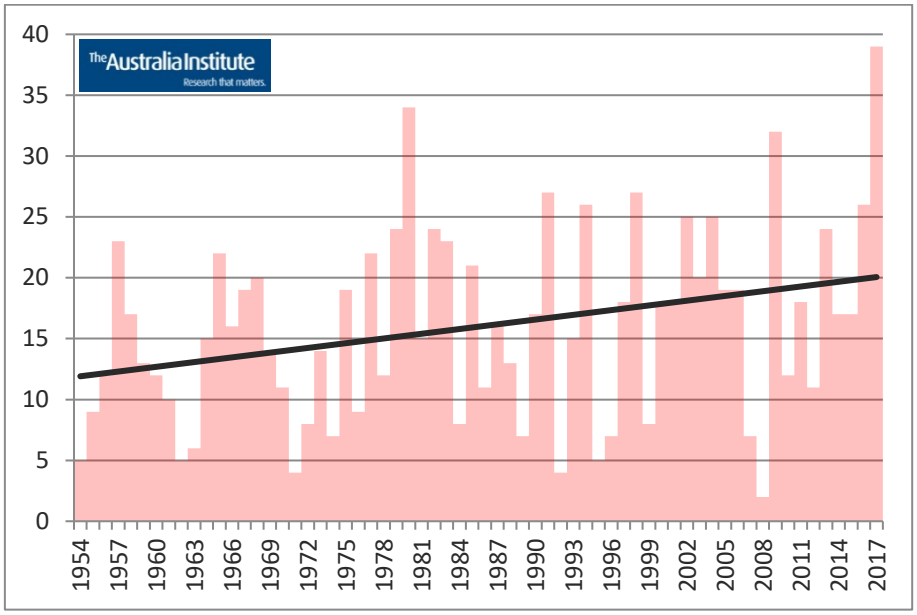
Suburbs

Because the Western Sydney figures are averages across the five suburbs, they do not show the particular changes that some suburbs will experience. The worst affected is Richmond, which could experience as many as 67 days over 35 degrees by 2090 in a current government policies scenario – a more than quadrupling of its historical average of 15 hot days. Three suburbs with long term historic data – Richmond, Paramatta and Bankstown – also feature graphs showing historic trends of extreme heat days. This data was not available for Penrith or Camden.

Richmond

Although its historical average (1981–2010) is 15 days over 35 degrees per year, according to BoM observations at Richmond RAAF the suburb has more recently experienced around 20 extreme heat days per year, and much higher in some years – up to 39 in 2017.

Figure 7: Days over 35 degrees per year in Richmond

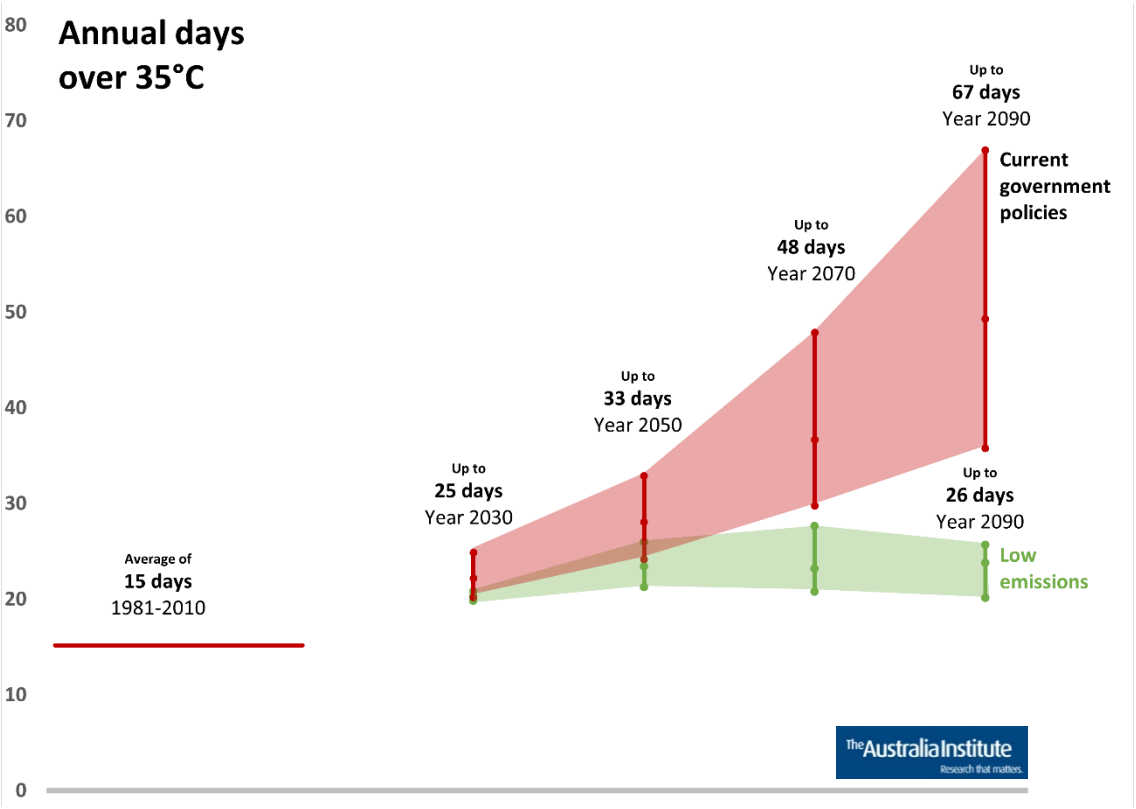


Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Under current government policies, Richmond's average number of days over 35 degrees would go from a historical average of 15 days per year to a maximum of 25 days by 2030, 33 days by 2050, 48 days by 2070 and 67 days by 2090.

Although Richmond will be the worst affected of the five Western Sydney suburbs assessed, it too benefits significantly from climate policies that would keep warming below 1.5 degrees, as represented by the RCP 2.6 scenario. Climate policies to keep warming below 1.5 degrees would reduce predicted days over 35 degrees to 21 days by 2030, 26 days by 2050, 28 days by 2070 and 26 days by 2090.

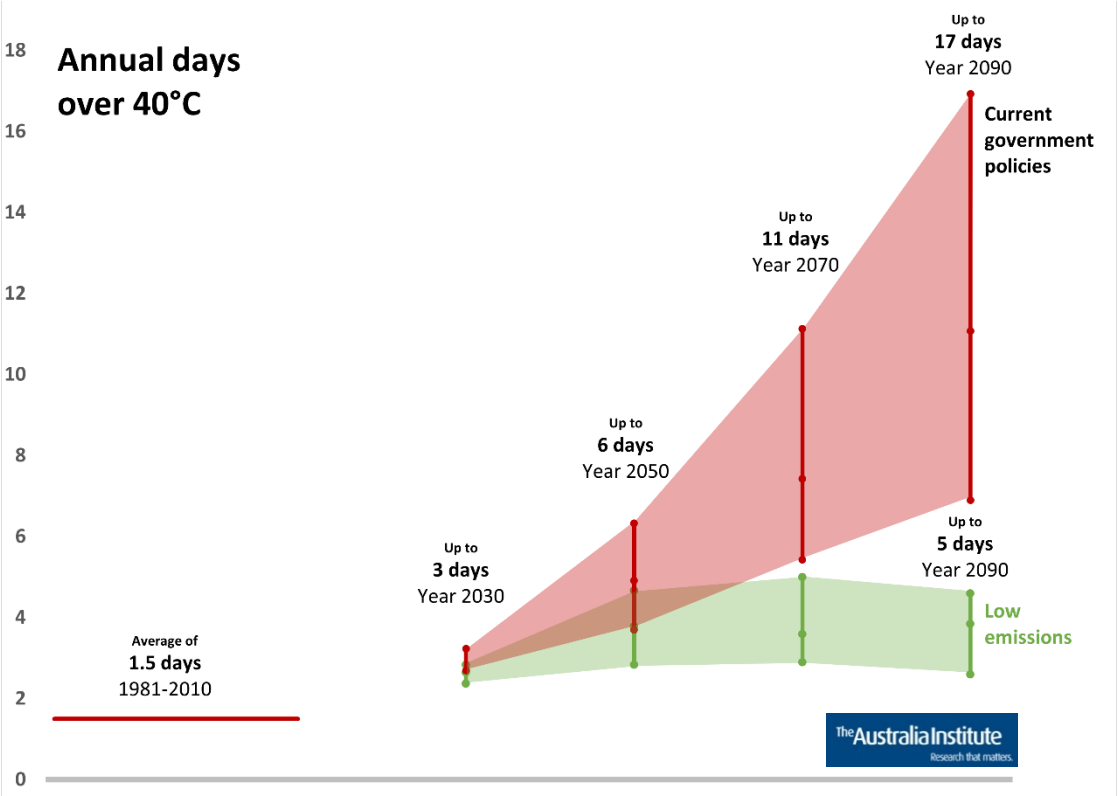
Figure 8: Forecast annual number of days over 35 degrees Richmond



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Richmond is also the suburb that will see the highest number of annual days over 40 degrees by 2090: up to 17. This is a more than tenfold increase from the historic average of 1.5 days per year.

Figure 9: Forecast annual number of days over 40 degrees Richmond



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 4: Richmond days over 35 degrees

	1981-2010	2030	2050	2070	2090
Historical	15.2				
Low emissions		19.8-20.8	21.3-26.0	20.8-27.7	20.2-25.7
Intermediate emissions		19.5-23.1	21.0-28.7	22.9-32.0	24.6-33.7
Current policies		20.2-24.9	24.2-32.9	29.8-47.9	35.8-66.9

Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 5: Richmond days over 40 degrees

	1981-2010	2030	2050	2070	2090
Historical	1.5				
Low emissions		2.4-2.8	2.8-4.7	2.9-5.0	2.6-4.6
Intermediate emissions		2.3-3.8	3.0-5.3	3.3-6.4	4.0-6.7
Current policies		2.7-3.2	3.7-6.3	5.4-11.1	6.9-16.9

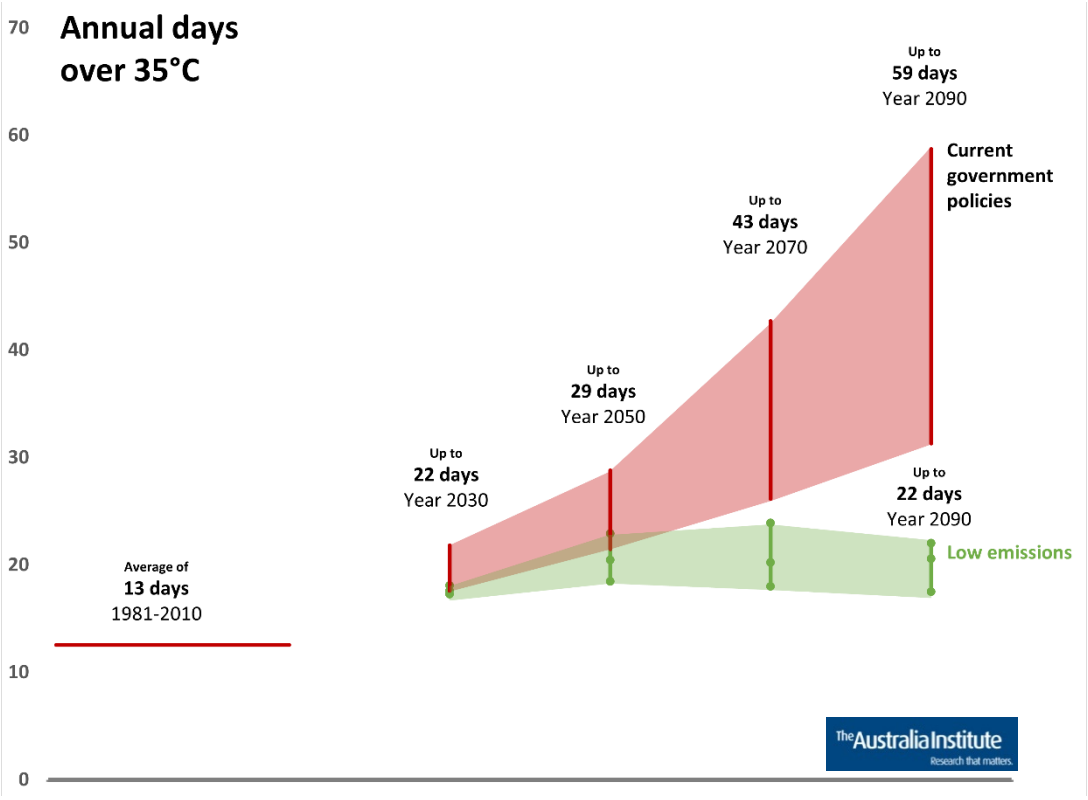
Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Penrith

Under current government policies in Penrith days over 35 degrees would go from a historical average of 13 days per year to a maximum of 22 days by 2030, 29 days by 2050, 43 days by 2070 and 59 days by 2090.

Penrith would benefit significantly from climate policies that would keep warming below 1.5 degrees, as represented by the RCP 2.6 scenario. Climate policies to keep warming below 1.5 degrees would reduce predicted days over 35 degrees to 18 days by 2030, 23 days by 2050, 24 days by 2070 and 22 days by 2090.

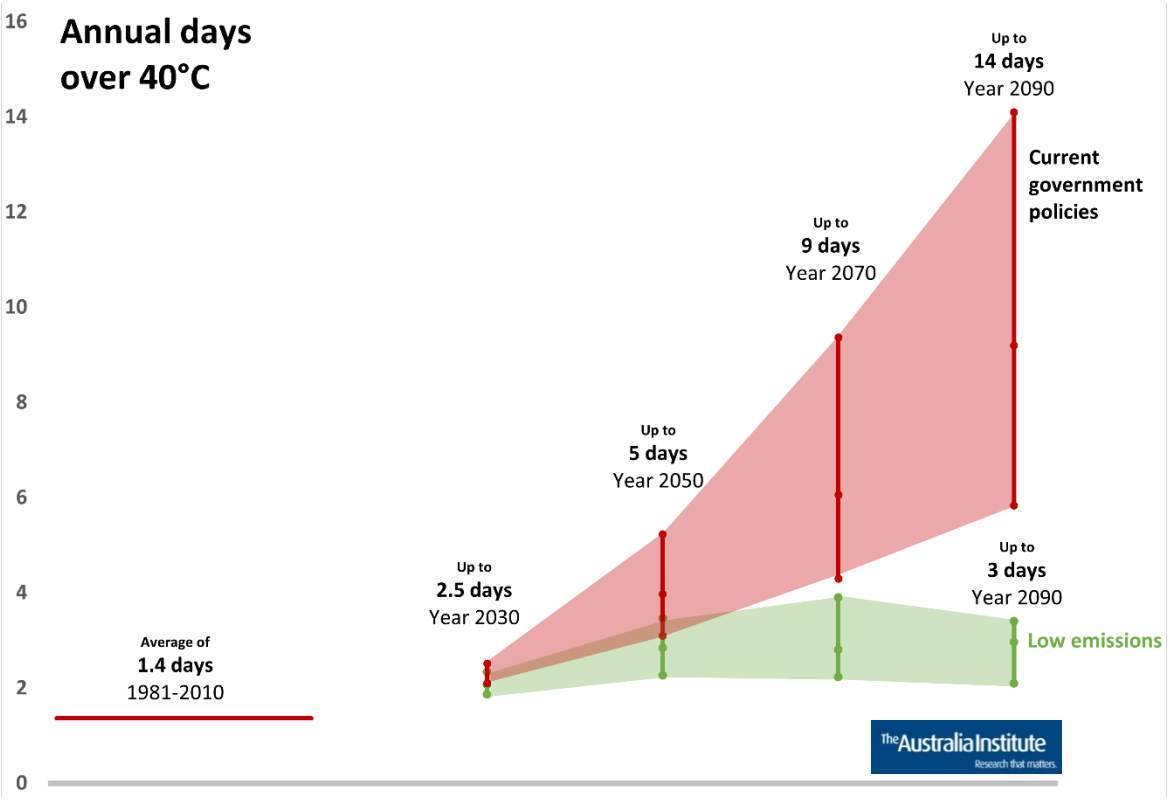
Figure 10: Forecast annual number of days over 35 degrees Penrith



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Penrith has historically experienced 1.4 days over 40 degrees per year. Without strong climate policies, this could increase to up to 9 days by 2070 and 14 days by 2090. With strong climate policies, the number of days over 40 degrees could be limited to 3 per year on average.

Figure 11: Forecast annual number of days over 40 degrees Penrith



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 6: Penrith days over 35 degrees

	1981-2010	2030	2050	2070	2090
Historical	12.6				
Low emissions		17.3-18.1	18.5-22.9	18.0-23.9	17.5-22.0
Intermediate emissions		16.9-20.1	18.3-24.7	20.2-28.6	21.7-28.9
Current policies		17.6-21.8	21.5-28.8	26.2-42.7	31.3-58.7

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 7: Penrith days over 40 degrees

	1981-2010	2030	2050	2070	2090
Historical	1.4				
Low emissions		1.9-2.3	2.3-3.5	2.2-3.9	2.1-3.4
Intermediate emissions		1.8-2.9	2.3-4.3	2.6-5.0	3.2-5.6
Current policies		2.1-2.5	3.1-5.2	4.3-9.4	5.8-14.1

The Australia Institute Research that matters.

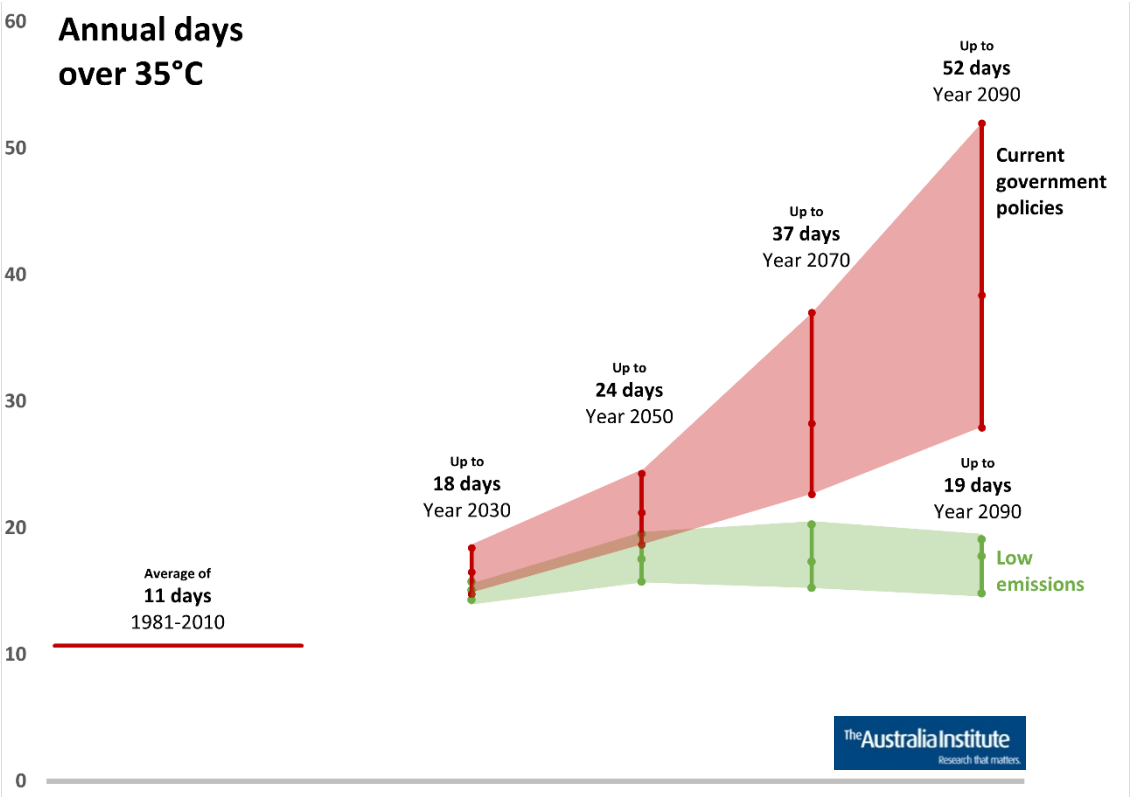
Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Camden

Under current government policies, Camden would see days over 35 degrees go from a historical average of 11 days per year to a maximum of 18 days by 2030, 24 days by 2050, 37 days by 2070 and 52 days by 2090.

Camden would benefit significantly from climate policies that would keep warming below 1.5 degrees, as represented by the RCP 2.6 scenario. Climate policies to keep warming below 1.5 degrees would reduce predicted days over 35 degrees to 16 days by 2030, 20 days by 2050, 20 days by 2070 and 19 days by 2090.

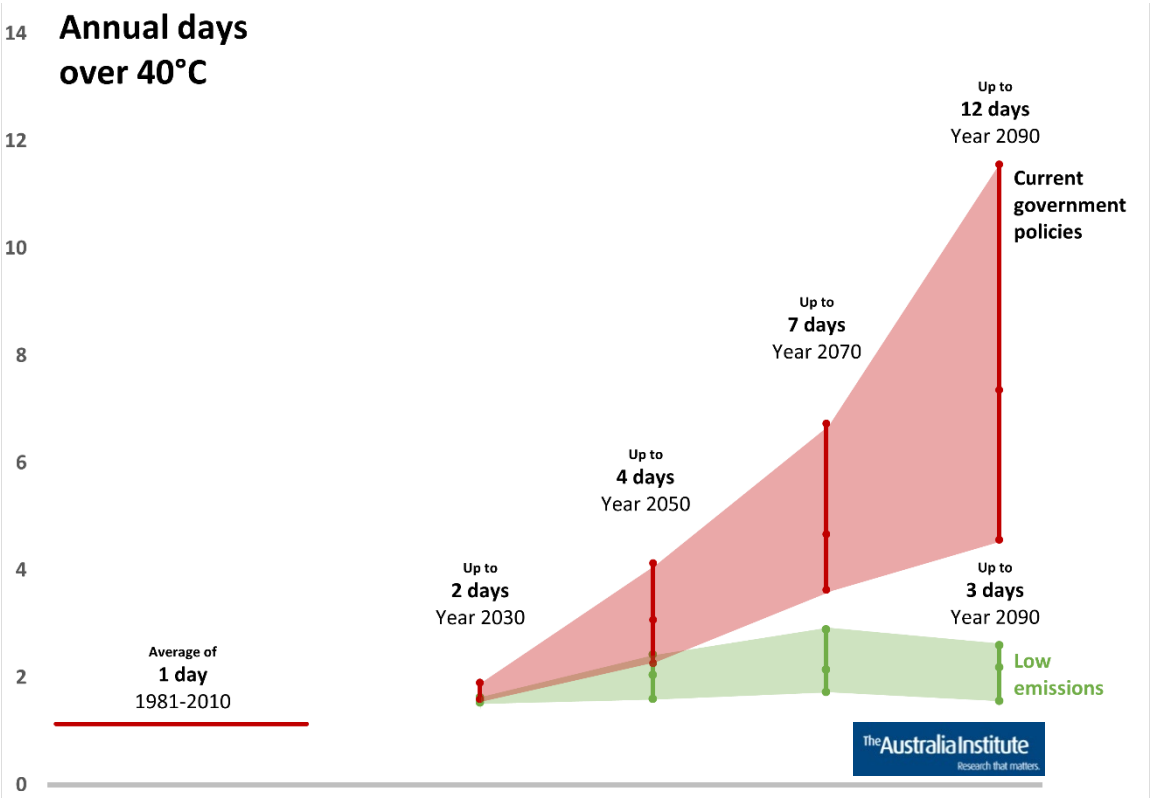
Figure 12: Forecast annual number of days over 35 degrees Camden



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Camden has historically experienced 1.1 days over 40 degrees per year. Without strong climate policies, this could increase to up to 7 days by 2070 and 12 days by 2090. With strong climate policies, the number of days over 40 degrees could be limited to 3 per year on average.

Figure 13: Forecast annual number of days over 40 degrees Camden



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 8: Camden days over 35 degrees

	1981-2010	2030	2050	2070	2090
Historical	10.7				
Low emissions		14.3-15.8	15.8-19.5	15.3-20.3	14.8-19.1
Intermediate emissions		14.1-17.1	15.7-21.1	17.6-24.2	19.0-24.9
Current policies		14.8-18.4	18.7-24.3	22.7-37.0	27.9-52.0

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 9: Camden days over 40 degrees

	Historical	2030	2050	2070	2090
Historical	1.1				
Strong action on climate		1.5-1.6	1.6-2.4	1.7-2.9	1.6-2.6
Some action on climate		1.4-2.2	1.8-3.1	1.9-3.6	2.5-4.1
Current policies		1.6-1.9	2.3-4.1	3.6-6.7	4.6-11.6

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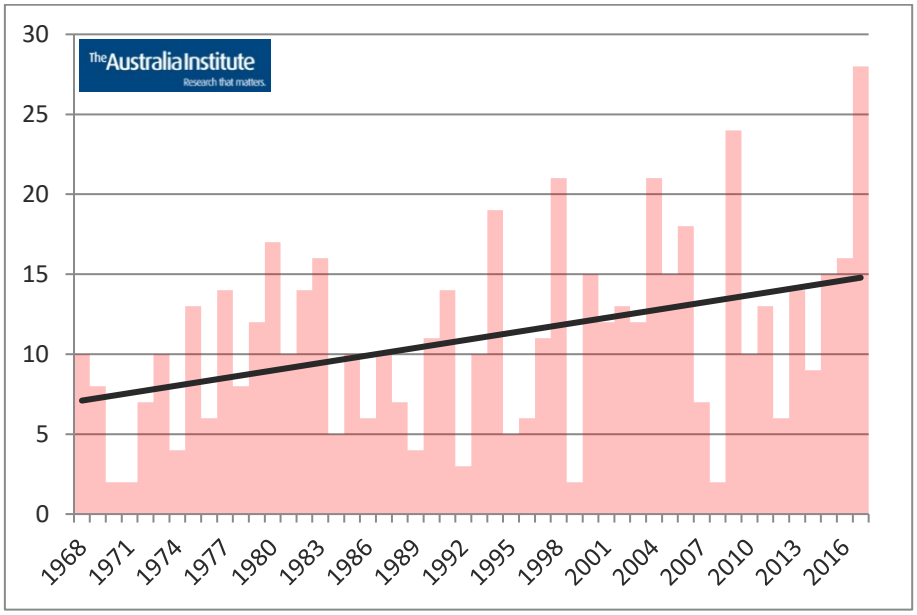
Research that matters.

Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Parramatta

Parramatta has a historical average of 8 days per year over 35 degrees, as observed between 1981 and 2010. However, more recent observations by BoM at North Parramatta record average extreme heat days closer to 15 per year, with 28 such days recorded in 2017.

Figure 14: Days over 35 degrees per year in North Parramatta

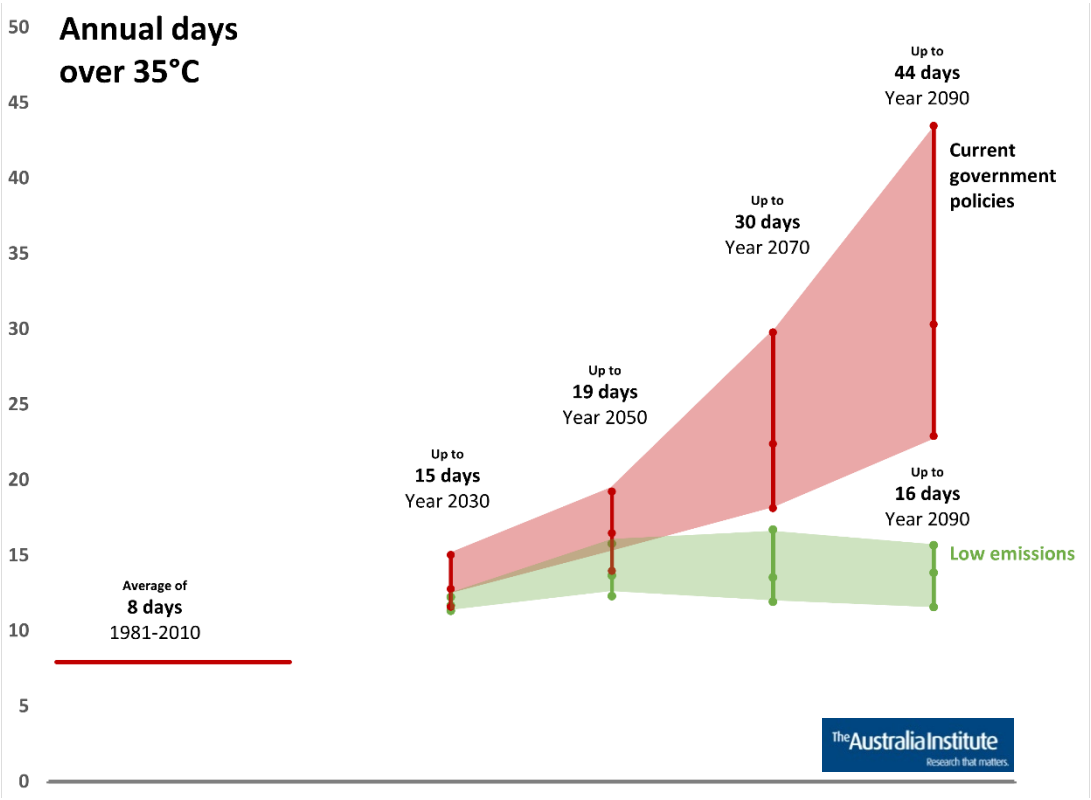


Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Under current government policies, in Parramatta days over 35 degrees would go from a historical average of 8 days per year to a maximum of 15 days by 2030, 19 days by 2050, 30 days by 2070 and 44 days by 2090.

Parramatta would benefit significantly from climate policies that would keep warming below 1.5 degrees, as represented by the RCP 2.6 scenario. Climate policies to keep warming below 1.5 degrees would reduce predicted days over 35 degrees to 12 days by 2030, 16 days by 2050, 17 days by 2070 and 16 days by 2090.

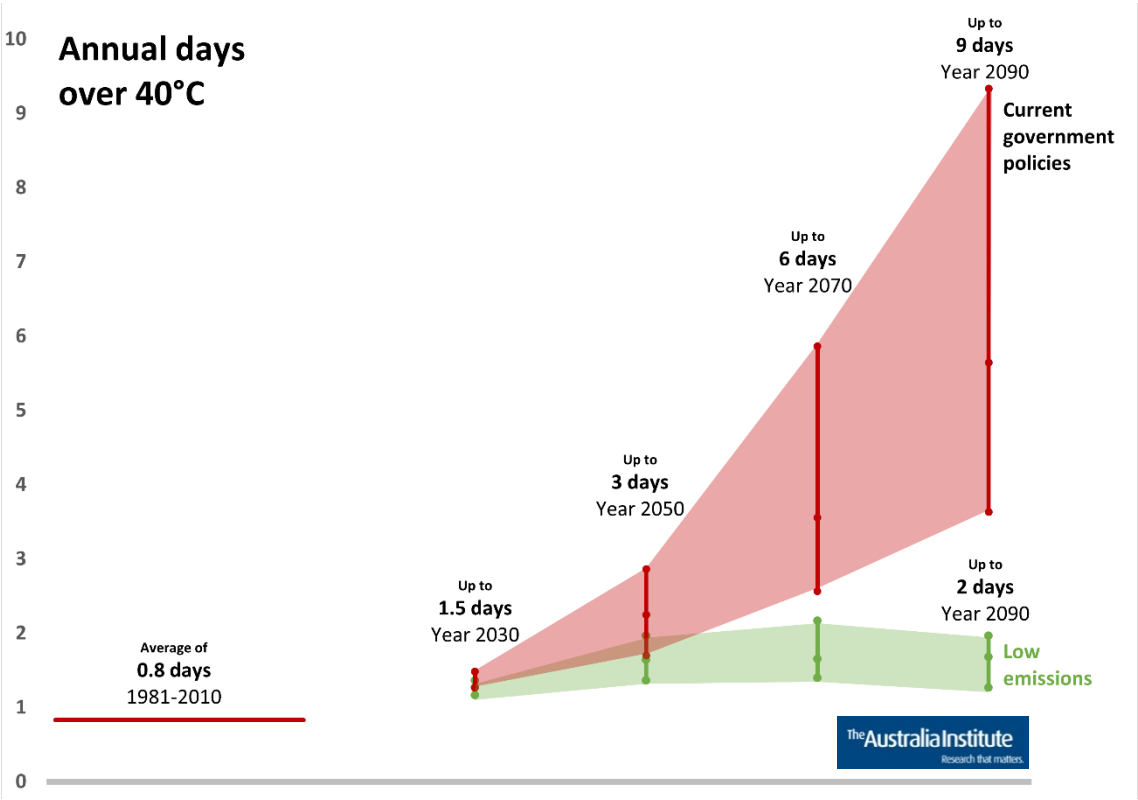
Figure 15: Forecast annual number of days over 35 degrees Parramatta



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Parramatta has historically experienced 0.8 days over 40 degrees per year. Without strong climate policies, this could increase to up to 6 days by 2070 and 9 days by 2090. With strong climate policies, the number of days over 40 degrees could be limited to 2 per year on average.

Figure 16: Forecast annual number of days over 40 degrees Parramatta



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 10: Parramatta days over 35 degrees

	1981-2010	2030	2050	2070	2090
Historical	7.9				
Low emissions		11.3-12.2	12.3-15.8	11.9-16.7	11.6-15.7
Intermediate emissions		11.2-13.1	12.9-17.7	13.4-19.7	14.4-20.9
Current policies		11.6-15.0	14.0-19.2	18.1-29.8	22.9-43.5

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 11: Parramatta days over 40 degrees

	1981-2010	2030	2050	2070	2090
Historical	0.8				
Low emissions		1.2-1.4	1.4-2.0	1.4-2.2	1.3-2.0
Intermediate emissions		1.1-1.5	1.4-2.5	1.6-2.9	1.8-3.2
Current policies		1.3-1.5	1.7-2.9	2.6-5.9	3.6-9.3

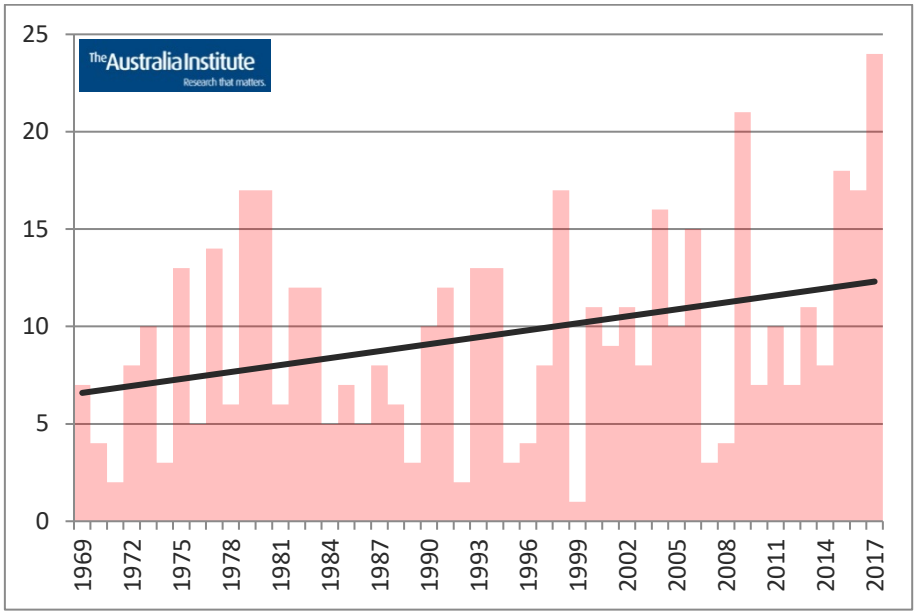
The Australia Institute Research that matters.

Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Bankstown

Bankstown has a historical average of seven days over 35 degrees per year, as measured between 1981 and 2010. However, as Figure 17 shows, BoM observations at Bankstown Airport have recorded much higher temperatures, including 24 extreme heat days in 2017.

Figure 17: Days over 35 degrees per year in Bankstown

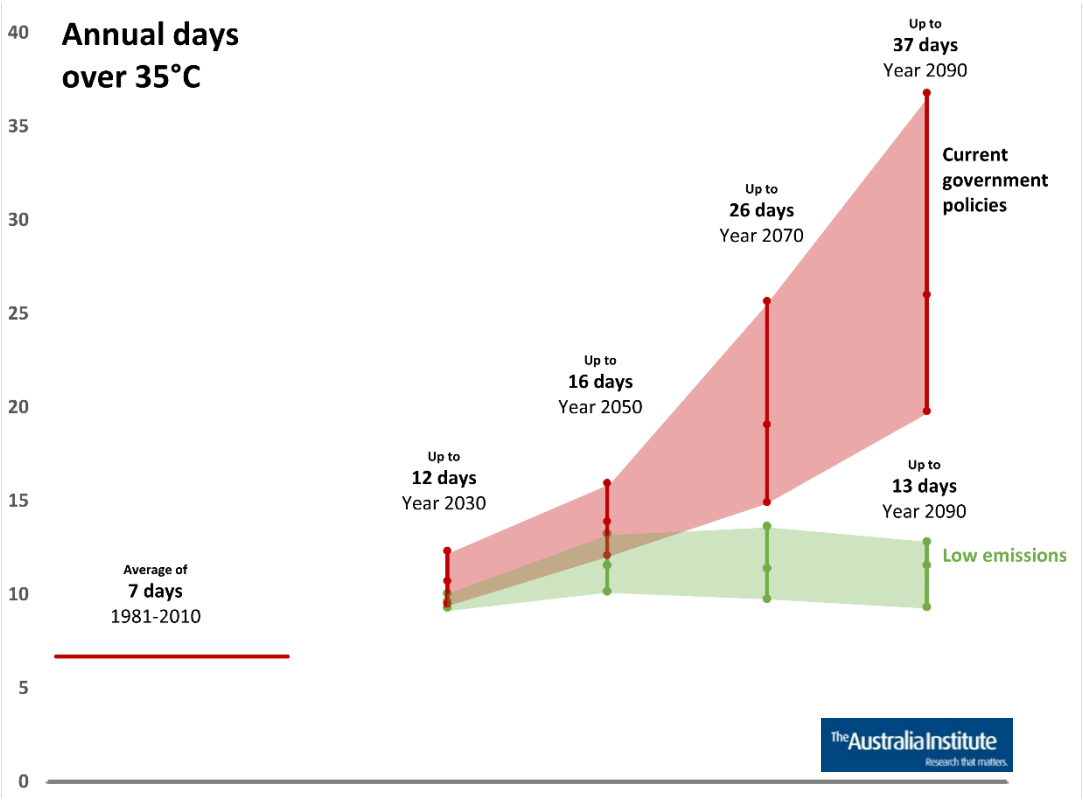


Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Under current government policies, days over 35 degrees in Bankstown would go from the historical average of 7 days per year to a maximum of 12 days by 2030, 16 days by 2050, 26 days by 2070 and 37 days by 2090.

Bankstown would benefit significantly from climate policies that would keep warming below 1.5 degrees, as represented by the RCP 2.6 scenario. Climate policies to keep warming below 1.5 degrees would reduce predicted days over 35 degrees to 10 days by 2030, 13 days by 2050, 14 days by 2070 and 13 days by 2090.

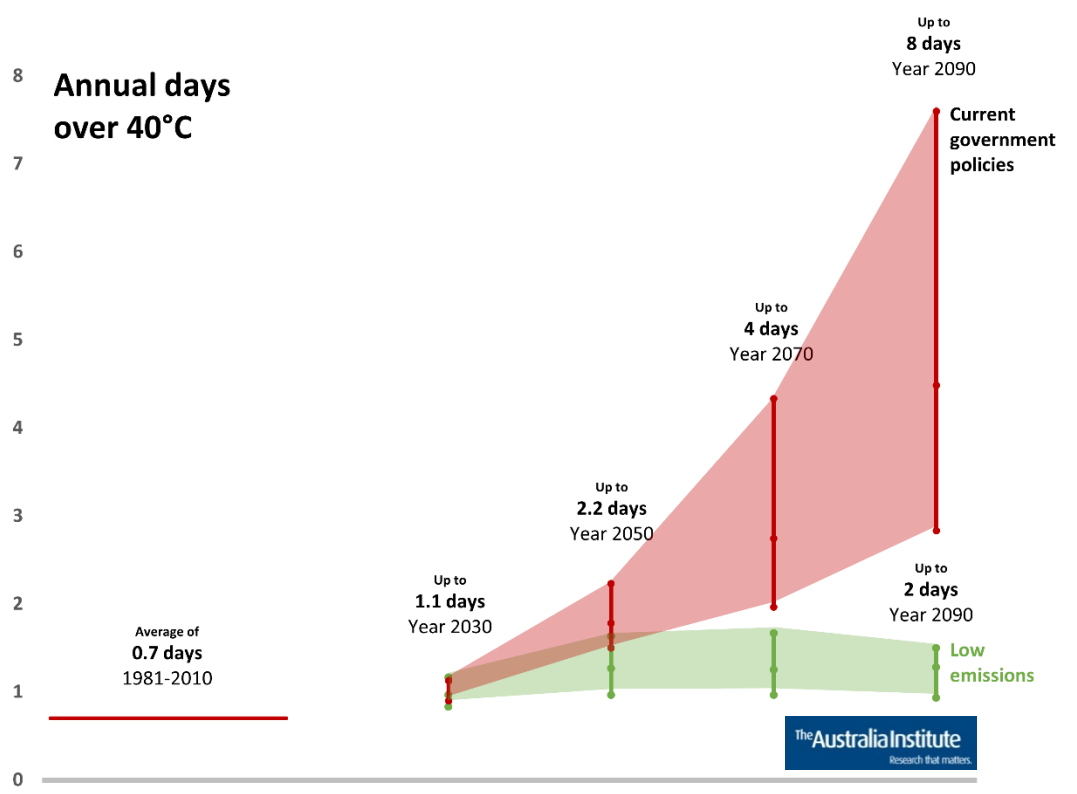
Figure 18: Forecast annual number of days over 35 degrees Bankstown



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Bankstown has historically experienced 0.7 days over 40 degrees per year. Without strong climate policies, this could increase to up to 4 days by 2070 and 8 days by 2090. With strong climate policies, the number of days over 40 degrees could be limited to 1.5 per year on average.

Figure 19: Forecast annual number of days over 40 degrees Bankstown



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 12: Bankstown days over 35 degrees

	1981-2010	2030	2050	2070	2090
Historical	6.7				
Low emissions		9.3-10.1	10.2-13.3	9.8-13.7	9.3-12.8
Intermediate emissions		9.1-11.0	10.9-15.0	11.8-16.8	12.4-18.1
Current policies		9.5-12.3	12.1-16.0	14.9-25.7	19.8-36.8

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 13: Bankstown days over 40 degrees

	1981-2010	2030	2050	2070	2090
Historical	0.7				
Low emissions		0.8-1.2	1.0-1.6	1.0-1.7	0.9-1.5
Intermediate emissions		0.9-1.3	1.1-1.8	1.2-2.3	1.5-2.4
Current policies		0.9-1.1	1.5-2.2	2.0-4.3	2.8-7.6

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Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Projected extreme heat days in summer

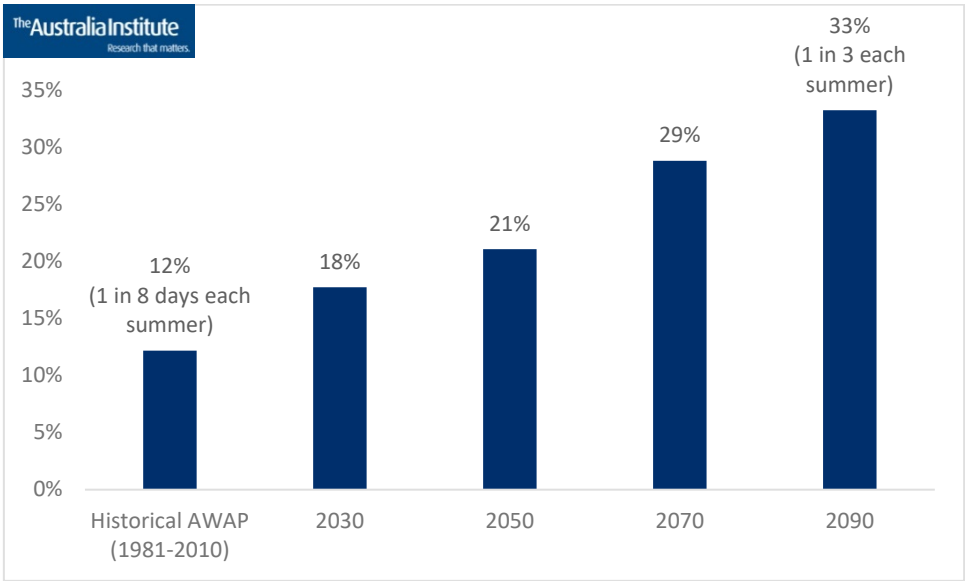
By looking at summer days exclusively, we can get a sense of how life will change during the hottest parts of the year. People, pets and wildlife that are used to enduring and working around the occasional hot summer day will be expected to endure many more hot days in the future, requiring changes to work, lifestyles and environments.

An indication of the projected distribution of extreme heat days throughout the year can also be gained from examining the CSIRO and BoM datasets. The CSIRO AWAP summer projections show Camden having a historical average of 7 days over 35 degrees between 1981–2010, or roughly one in twelve summer days, and Richmond having a historical average of 11 days over 35 degrees between 1981–2010, or one in eight.

Figure 20 demonstrates the dramatic increase in the frequency of extreme heat days in summer for Richmond. Under a current policies scenario on greenhouse emissions, the CSIRO and BoM estimate that Richmond could experience 16 days over 35 degrees in 2030, 19 over 35 degrees in 2050, 26 days over 35 degrees in 2070 and 30 days over 35 degrees in 2090 – in other words, going from one in eight summer days over 35 degrees to one in three summer days over 35 degrees.

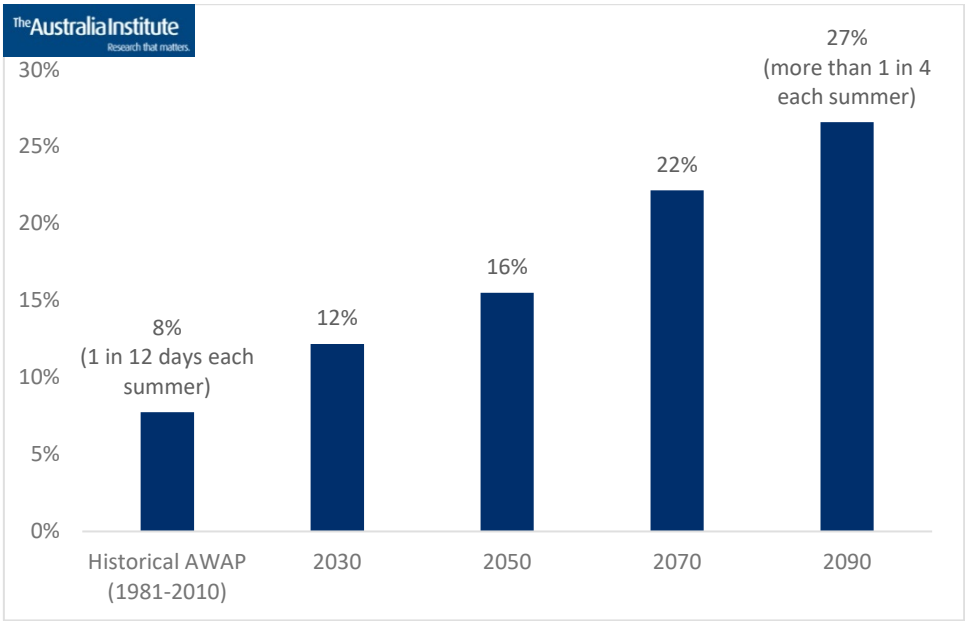
Figure 21 demonstrates a similar increase for Camden. Under a current policies scenario on greenhouse emissions, the CSIRO and BoM estimate that Camden could experience 11 days over 35 degrees in 2030, 14 over 35 degrees in 2050, 20 days over 35 degrees in 2070 and 24 days over 35 degrees in 2090 – in other words, going from one in 12 summer days over 35 degrees to one in four summer days over 35 degrees.

Figure 20: CSIRO–BoM projections summer days over 35 degrees (Richmond)



Source: CSIRO and Bureau of Meteorology (2015) *Climate projections: Climate threshold calculator*, https://www.climatechangeinaustralia.gov.au/en/climate-projections/explore-data/threshold-calculator/

Figure 21: CSIRO–BoM projections of summer days over 35 degrees (Camden)



Source: CSIRO and Bureau of Meteorology (2015) *Climate projections: Climate threshold calculator*, https://www.climatechangeinaustralia.gov.au/en/climate-projections/explore-data/threshold-calculator/

The significant increase in projected extreme heat days make this period extremely dangerous to human health and wellbeing.

Table 14: Richmond December–February hot days

Richmond	Above 35 degrees	Above 37 degrees	Above 40 degrees
Historical (1981–2010)	11	6	1
2030	16	9	3
2050	19	11	4
2070	26	15	6
2090	30	18	8

Note and Source: RCP 8.5 scenario; HadGEM2-CC model, CSIRO and Bureau of Meteorology (2015) *Climate projections: Climate threshold calculator*, https://www.climatechangeinaustralia.gov.au/en/climate-projections/explore-data/threshold-calculator/

Table 15: Camden December–February hot days

Camden	Above 35 degrees	Above 37 degrees	Above 40 degrees
Historical (1981–2010)	7	3	1
2030	11	6	2
2050	14	7	2
2070	20	11	4
2090	24	14	5

Note and Source: RCP 8.5 scenario; HadGEM2-CC model, CSIRO and Bureau of Meteorology (2015) *Climate projections: Climate threshold calculator*, https://www.climatechangeinaustralia.gov.au/en/climate-projections/explore-data/threshold-calculator/

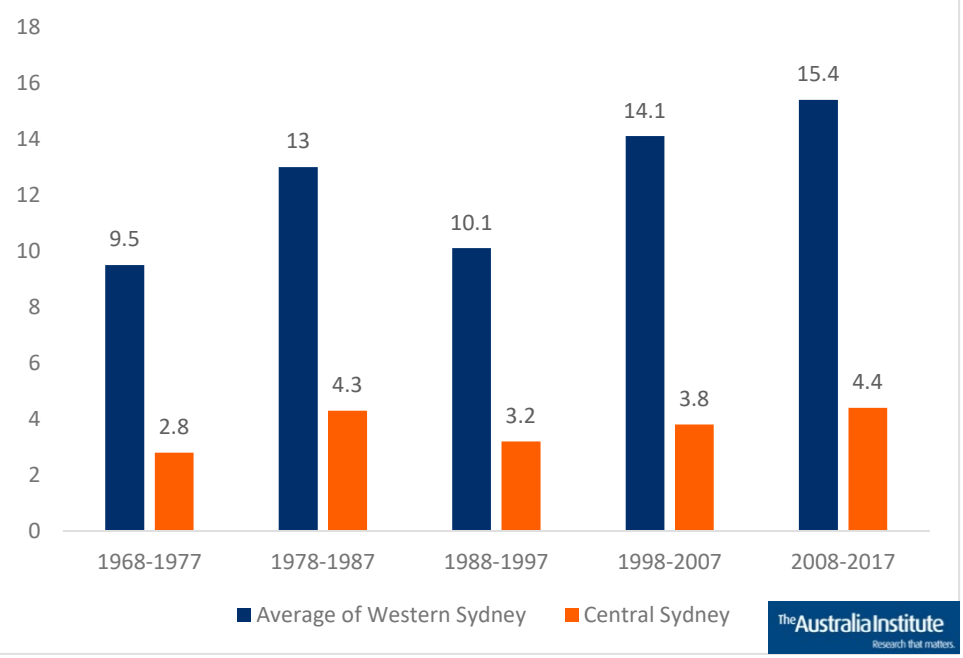
Elsewhere in Sydney

The CSIRO projects increases in hot days across all of Greater Sydney. However, Western Sydney is already hotter than places further west – like the Blue Mountains – or further east – like the coastal parts of Sydney where temperatures are moderated by the ocean.

In Western Sydney the decade 1968–1977 saw 9.5 days per year over 35 degrees, 4.8 over 37 degrees and 1.3 days over 40 degrees. By the decade 2008–2017, there were 15.4 days over 35 degrees, 8.6 over 37 degrees and 3.1 over 40 degrees. This is evidence of a broad and dramatic trend towards hotter days in just four decades.

As shown in Figure 22 and Table 16 below, Central Sydney has also warmed over the decades, from 2.8 days per year over 35 degrees in the decade 1968–1977 to 4.4 days per year over 35 degrees in the decade 2008–2017.

Figure 22: Average annual days over 35 degrees by decade – comparison with Sydney

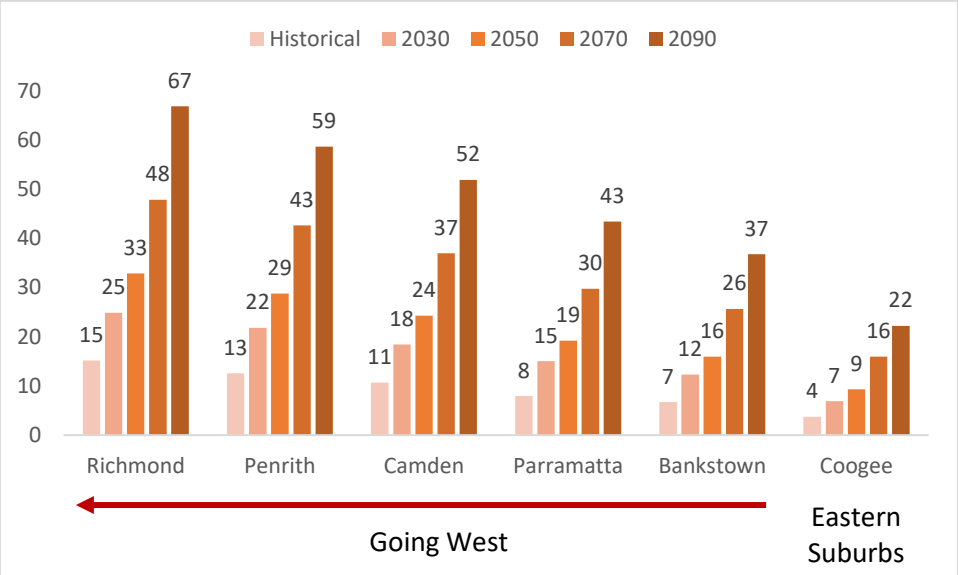


Source: Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Figure 23 shows days over 35 degrees by location, with historical data and BoM–CSIRO's RCP 8.5 projections (current policies, highest among the eight models). They show a dramatic increase in hot days in Sydney's Eastern Suburbs (centred on Coogee); from 4 per year historically to 22 per year by 2090).

These dramatic increases will have health and environmental effects, but it is worth emphasising that people in Western Sydney are already experiencing conditions like this. The Eastern Suburbs by 2070, during runaway climate change, will have as many days over 35 degrees per year as Richmond already has per year. In 2070, the Eastern Suburbs could have around as many hot days (16 in a year) as Richmond has already had historically (15 in a year). By 2090, the worst-case scenario has the Eastern Suburbs experiencing 22 hot days in a year; Richmond in the worst-case scenario passes this threshold 60 years earlier – by 2030.

Figure 23: Days over 35 degrees in selected locations (current policies scenario)



Source: CSIRO and Bureau of Meteorology (2018) *Climate projections,* provided on request

Table 16: Average number of hot days per year degrees Central Sydney

Decade	Over 35 degrees	Over 37 degrees	Over 40 degrees
1968–1977	2.8	1.3	0.2
1978–1987	4.3	2.6	0.3
1988–1997	3.2	0.9	0.3
1998–2007	3.8	1.7	0.2
2008–2017	4.4	2.4	0.7
Average 1968–2017	3.7	1.8	0.3

Source: Data from Observatory Hill, Bureau of Meteorology (n.d.) *Climate data online,* http://www.bom.gov.au/climate/data/index.shtml

Why is Western Sydney so hot?

Western Sydney already suffers from extreme temperatures well above the rest of Sydney with temperatures of 6–10 degrees higher during summer extreme events compared to the eastern suburbs.[23]

A number of factors contribute to the hot temperatures experienced by Western Sydney, including the Urban Heat Island effect. Western Sydney is also far enough inland that it does not benefit from the coastal breezes that help to cool the Eastern Suburbs of Sydney.[24] The Blue Mountains to the west also trap hot air, despite being relatively cool themselves.[25]

Highly urbanised areas create an environment that is divergent from the surrounding rural areas. Research has found that due to urban structures like skyscrapers – along with roads, pavements, roofs and diminished vegetation cover – cities becomes warmer as more heat is absorbed in the materials during day and then released at night, which increases night-time temperatures.[26]

This creates an Urban Heat Island effect (UHI) not just on these surfaces but also in the atmosphere. This is more prominent during summer as temperatures rise. During the daytime, UHI causes exposed surfaces like roofs to heat to temperatures up to 50 degrees hotter than the air while rural areas remain closer to the atmospheric temperatures, creating an 'island' effect in cities.[27]

It is at night though when UHI has its largest influence on atmospheric heat extremes. Heat absorbed in urban structures during the day is slowly released after sunset

[23] UNSW (2017) *Cooling Western Sydney A strategic study on the role of water in mitigating urban heat in Western Sydney*, https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mty4/~edisp/dd_168965.pdf

[24] Parry (2018) *How Western Sydney is tacking the mysterious 'heat island' effect behind rising temperatures,* https://www.abc.net.au/news/2018-03-01/how-western-sydney-is-tackling-the-heat-island-effect/9361156

[25] Arlington (2017) *Sydney weather: How urbanisation creates hot microclimates in our suburbs,* https://www.canberratimes.com.au/environment/weather/sydney-weather-how-urbanisation-creates-hot-microclimates-in-our-suburbs-20170209-gu9b02.html

[26] Sharifi and Soltani (2017) *Daily variation of urban heat island effect and its correlations to urban greenery: A case study of Adelaide,* Frontiers of Architectural Research 6.

[27] United States Environmental Protection Agency, *Learn About Heat Islands,* https://www.epa.gov/heat-islands/learn-about-heat-islands

compared to heat in vegetated areas. This produces much higher temperature shifts in the air overnight than in equivalent rural areas.[28] On a clear calm night, the US Environmental Protection Agency states that the temperature difference can be as high as 12 degrees between urban and rural areas.[29] Studies also raise the concern that night temperature extremes carry the higher risks of mortality as people are unable to recover from daytime heat stress.[30]

The Urban Heat Island effect has been well documented in Western Sydney,[31] and councils are looking at measures that would reduce the effect.[32]

[28] Argueso et al. (2015) *Effects of City Expansion on Heat Stress under Climate Change Conditions,* PLoS ONE 10.

[29] United States Environmental Protection Agency, *Learn About Heat Islands,* https://www.epa.gov/heat-islands/learn-about-heat-islands

[30] Zhao et al. (2018) *Interactions between urban heat islands and heat waves,* Environmental Research Letters 13.

[31] Parry (2018) *How Western Sydney is tacking the mysterious 'heat island' effect behind rising temperatures,* https://www.abc.net.au/news/2018-03-01/how-western-sydney-is-tackling-the-heat-island-effect/9361156

[32] Arlington (2017) *Sydney weather: How urbanisation creates hot microclimates in our suburbs,* https://www.canberratimes.com.au/environment/weather/sydney-weather-how-urbanisation-creates-hot-microclimates-in-our-suburbs-20170209-gu9b02.html

Health and productivity impacts of extreme heat

The impact of extreme heat on human health, particularly over extended periods, is severe. Although people living in hot areas do acclimatise to help cope with extreme temperatures, there are limits.[33] A large increase in days over 35 degrees will push past those limits.

The health impacts of increasing extreme heat can include both direct heat illnesses such as heat exhaustion and indirect illnesses such as heart failure and even death.

WorkSafe Queensland lists a range of illnesses arising directly from extreme temperatures from mild cramps, rashes, and dehydration to severe injuries such as heat stroke, exhaustion and even death if treatment is delayed.[34] As climate change worsens this can be expected to put people that are more vulnerable at increasingly greater risk.

The groups most vulnerable to heat impacts include the elderly, the very young, and those with pre-existing health conditions. Illnesses such as angina, kidney disease, and diabetes are at higher risk of being triggered or exacerbated when people are unable to maintain a safe body temperature.[35]

People suffering from mental disorders are also vulnerable. This vulnerability to extreme heat can result from altered behavioral responses to high temperatures or the impact of medications.

As stated earlier, irritability and psychological stress also increase in heat. When hot days are combined with hot nights, heat load and stress carry over and the body has no opportunity to cool down and recover. Studies show that there is an association between the mortality of not just stroke patients but also the general population and

[33] Hanna and Tait (2015) *Limitations to thermoregulation and acclimatisation challenges human adaptation to global warming,* Int J Environ Res Public Health 12.
[34] WorkSafe Queensland (n.d.) *Health effects,* https://www.worksafe.qld.gov.au/injury-prevention-safety/hazardous-exposures/heat-stress/health-effects
[35] Hanna et al. (2016) *The silent killer: Climate Change and the Health Impacts of Extreme Heat,* The Climate Council, https://research-management.mq.edu.au/ws/portalfiles/portal/72578140/72578105.pdf

high night temperatures.[36] The 'synergistic effect' of night humidity, increased temperatures, and UHI in heatwaves has been estimated in some studies to double general mortality risk by the end of the century under RCP 8.5.[37] Often underrated, major heatwaves have caused more deaths in the last century in Australia than bushfires, cyclones, earthquakes, floods and severe storms put together put together.[38]

Extreme heat nights also cause increased insomnia and lack of rest. This is exacerbated by the higher relative humidity at overnight time. As sleep is vital for healthy human functioning, a deficit means more susceptibility to disease, obesity, chronic illness and harm to our psychological and cognitive functioning.[39]

Productivity decreases significantly under these stresses as people are affected with the consequences of extreme heat. Workplace safety and the ability to work declines. This can also be displayed in economic terms as costs rise to account for the lack of labour productivity and changes needed in workplaces.[40]

The cost of lost productivity because of extreme heat in Australia has been estimated at almost $7 billon in 2013-14 alone.[41]

As Western Sydney is reliant on the services, transport, construction and retail industries for employment, this would have detrimental impacts to the region.

[36] Murage et al. (2017) *Effect of night-time temperatures on cause and age-specific mortality in London,* Environmental Epidemiology 1; Roye (2017) *The effects of hot nights on mortality in Barcelona, Spain,* International Journal of Biometeorology 61.
[37] Zhao et al. (2018) *Interactions between urban heat islands and heat waves,* Environmental Research Letters 13.
[38] Hanna et al. (2016) *The silent killer: Climate Change and the Health Impacts of Extreme Heat,* The Climate Council
[39] Obradovich et al. (2017) *Nighttime temperature and human sleep loss in a changing climate,* Science Advances 3.
[40] Climate Council (2014) *Heatwaves: Hotter, Longer, More Often,* https://www.climatecouncil.org.au/uploads/9901f6614a2cac7b2b888f55b4dff9cc.pdf
[41] Zander, Opperman and Garnet, Extreme heat poses a billion-dollar threat to Australia's economy, https://theconversation.com/extreme-heat-poses-a-billion-dollar-threat-to-australias-economy-41153

Impacts on infrastructure

Extreme heat can cause failures to critical infrastructure, particularly transport and electricity supply. Coal and gas power stations in particular are very vulnerable to extreme heat, experiencing both reduced output and an increased level of breakdowns. This is exacerbated by high electricity demand as a result increased use of air-conditioning during extreme heat conditions. During the February 2017 heatwave in New South Wales, 20% of coal and gas generation (2,438 MW) failed to deliver during the peak demand period on the heatwave day 10th of February, leading to load shedding and narrowly avoiding widespread blackouts.[42]

In a highly urbanised environment like Western Sydney, air-conditioning can be critical to people's wellbeing during extreme heat. Electricity blackouts during heatwaves lead to the loss of air-conditioning when it is most essential. During the 2009 Heatwave in Melbourne on the evening of the 30th of January, 500,000 people were left without power on a day that reached 44 degrees. There were 374 deaths recorded as a result of this heatwave overall. The estimated economic cost of the heatwave was $800 million.[43]

Transport is also vulnerable to extreme heat. Roads can melt[44] and rail can buckle.[45] Some public transport does not have air-conditioning or the air-conditioning can break down, causing great distress to commuters.[46]

[42] Ogge and Aulby (2017) *Can't stand the heat; The energy security risk of Australia's reliance on coal and gas generators in an era of increasing heatwaves*, http://www.tai.org.au/sites/defualt/files/P454%20Can%27t%20stand%20the%20heat%20FINAL%202.31.pdf

[43] NCCARF (2010) *Impacts and adaptation responses of infrastructure communities to heatwaves,* https://www.nccarf.edu.au/business/sites/www.nccarf.edu.au.business/files/attached_files_publications/Pub%2013_10%20Southern%20Cities%20Heatwaves%20-%20Complete%20Findings.pdf

[44] Cheer (January 2018) Traffic delays after 10 kilometres of Victoria's Hume Freeway melts, https://www.sbs.com.au/news/traffic-delays-after-10-kilometres-of-victoria-s-hume-freeway-melts

[45] Lauder (2009) Melbourne railway buckles under heat, http://www.abc.net.au/worldtoday/content/2008/s2477350.htm

[46] Robertson (January 2017), Eastern Australia swelters under heatwave as hottest January on record looms, https://www.theguardian.com/australia-news/2017/jan/18/eastern-australia-swelters-under-heatwave-as-hottest-january-on-record-looms

With the long travel times for Western Sydney commuters and a transport system already under stress, Western Sydney is particularly vulnerable to infrastructure damage caused by heatwaves. [47]

[47] Sydney Business Chamber (2018) Good Public Transport Needed in Western Sydney, https://www.thechamber.com.au/Media/Good-Public-Transport-Needed-in-Western-Sydney

Conclusion

An increase in days of temperature over 35 degrees will have severe impacts on human health, including increased rates of heat-related deaths.

Western Sydney has already experienced unprecedented heatwaves last summer, affecting people's ability to work and enjoy the outdoors, to play and watch sport. Given how Western Sydney is already disproportionately affected by the heat, strong emissions reduction policies are in the region's interests.

Climate change will not affect everyone equally. People living and working in Western Sydney will endure many more hot days than people in other parts of the state will endure – and Western Sydney will become an increasingly undesirable place to live relative to cooler parts of NSW.

Strong climate change policies to reduce Australia's emissions and fossil fuel use production, as well as calls for global action, are in the best interests of Western Sydney and Australia as a whole.

Appendix: Sites chosen

Table 17: BoM–CSIRO data

Descriptions	Latitude	Longitude
Richmond	-33.60	150.70
Penrith	-33.75	150.70
Parramatta	-33.80	151.00
Bankstown	-33.90	151.00
Camden	-34.05	150.65
Coogee (for comparison)	-33.90	151.25

Note: Decimal latitude and longitude are used. The data is available for 00.05 by 00.05 degree squares, which roughly equates to five kilometres by five kilometres.