Appin (Part) Precinct Plan - Urban Heat Assessment

Prepared for Walker Corporation

Civille

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EXECUTIVE SUMMARY

Walker Corporation Pty Ltd and Walker Group Holdings Pty Ltd (together the Proponent) have prepared a Proposal to support the rezoning of the Appin (Part) Precinct. This land is located within the Greater Macarthur Growth Area's land release area – the Appin and North Appin Precincts. Civille has been engaged by the Proponent to prepare an urban heat assessment to support a Structure Plan for the Appin (Part) Precinct. This precinct is expected to be developed into primarily low and medium density residential lots, with supporting schools, centres, and infrastructure.

The Appin (Part) Precinct is exposed to both heat and cold. Heat is a particular concern due to its health risks for future residents. The area experiences an average of 17.1 hot (>35°C) days per year, including 2.9 days where the temperature peaks over 40°C. The number of hot days is expected to increase as the climate changes over the coming decades.

Therefore, development in the Appin (Part) Precinct should be designed to:

1. Reduce the urban heat island effect, to minimise overheating of the precinct as a whole.
2. Promote thermally comfortable conditions at a human scale within the development, so that people can adapt to a hotter climate.

This is consistent with the Western Sydney District Plan (Greater Sydney Commission 2018b) Planning Priority (W20) "Adapting to the impacts of urban and natural hazards and climate change".

Green, blue and grey infrastructure can all play a role in mitigating the impacts of urban heat and within the Appin (Part) Precinct, the following measures are recommended:

- Set energy efficiency benchmarks for non-residential buildings.
- Provide infrastructure to support local use of public transport, active transport, and electric vehicles.
- Adopt canopy cover and green cover targets for the precinct.
- Adopt a target for the precinct to retain water in the landscape.
- Set a cool roof benchmark.
- Encourage the use of 'cool paving' materials, with high thermal emittance, and/or permeability.
- Consider orientation of site features to catch prevailing breezes and maximise shade in summer.
- Set benchmarks for canopy cover and green cover in streets, parks, and on private land.
- Prioritise canopy cover where it will shade paved areas and building walls, particularly northern and western walls. Where canopy cover is impractical, shade structures can also be effective.
- Encourage irrigation or passive irrigation of trees and other vegetation.
- Encourage the use of WSUD features that retain water in the landscape.
- Set benchmarks for shade cover in key places such as parks, town centres, and transport nodes.
- Provide outdoor 'cool zones' including targeted measures such as additional shade and evaporative cooling.
- Prioritise all the above where people are most likely to be present and active outdoors, particularly vulnerable people.
- Encourage alternative water supplies for non-residential development.

The report provides guidance on each of these measures, with specific commitments subject to further analysis as planning for the precinct continues. The report concludes:

- There are opportunities in the precinct's planning and design to reduce the heat island effect and reduce the impacts of urban heat at a human scale.
- Green, blue, and grey infrastructure all play a role.
- A 40% tree canopy target is recommended for the Appin (Part) Precinct as a whole.
- Appropriate targets for retaining water in the landscape and a cool roof standard should be considered as part of further planning.

The Proposal can be supported in its current form.

1 INTRODUCTION

1.1 THE APPIN PROJECT

Greater Sydney's population is projected to grow to approximately 6.1 million by 2041 – over a million more people than currently live in the region.

The NSW Government has identified Growth Areas as major development areas that will assist in accommodating this growth. The Greater Macarthur Growth Area (**GMGA**) is one such growth area and is a logical extension of the urban form of south-west Sydney. The GMGA is divided into precincts. The Appin Precinct and North Appin Precincts are the southernmost land release precincts of the GMGA. The goal is to deliver 21,000+ dwellings.

The land is to be rezoned and released for development to achieve this goal. A submission has been prepared by Walker Corporation Pty Limited and Walker Group Holdings Pty Limited (the **Proponent**) to rezone 1,378 hectares of land (**the site**) within the Appin Precinct from RU2 Rural Landscape to the following zones:

Urban Development Zone

Zone 1 Urban Development (UD)

Special Purposes Zone

Zone SP2 Infrastructure (SP2)

Conservation Zone

Zone C2 Environmental Conservation (C2)

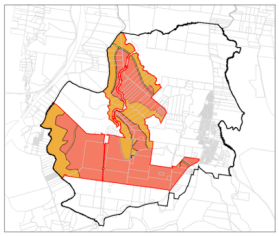
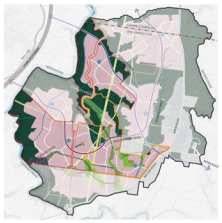
The zonings are shown on the Appin (Part) Precinct Plan (**the precinct plan**). 'The precinct plan' will be incorporated into the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 and contain the provisions (clauses and maps) that will apply to 'the site.' 'The precinct plan' envisages the delivery of 12,000+ new homes.

A structure plan has been prepared for the site and is shown on the Appin (Part) Precinct Structure Plan (**the structure plan**). It identifies staging and the first stage to be developed – Release Area 1. Release Area 1 is anticipated to deliver 3,500+ dwellings.

The submission is aligned with strategic land use planning, State and local government policies and infrastructure delivery. The development potential is tempered by a landscape-based approach that protects the environment and landscape values, shaping the character of new communities. A series of residential neighbourhoods are to be delivered within the landscape corridors of the Nepean and Cataract Rivers, supported by local amenities, transit corridors and community infrastructure.

The submission includes a hierarchy of plans. The plans and their purpose are summarised in Table 1.

Table 1: Title and purpose of plans

(1) APPIN & NORTH APPIN PRECINCTS INDICATIVE PLAN	(2) APPIN (PART) PRECINCT PLAN (*THE PRECINCT PLAN*)	(3) APPIN (PART) PRECINCT STRUCTURE PLAN (*THE STRUCTURE PLAN*)
Broader context and for information purposes only. It has no statutory weight. It identifies: • *Higher-order transport network* • *Centres hierarchy* • *School sites* • *Conservation areas* • *Residential areas* *Cultural sites and connections*	*It shows the land proposed to be rezoned and incorporated into a new schedule in the Western Parkland City SEPP 2021.* *The precinct plan contains the development provisions (clauses and maps) applicable to the site and is used in assessing development applications.*	*Structure plan for the site, showing staging of release areas.* *Development is to be generally consistent with the structure plan. It illustrates land use components including (but not limited to):* • *Low and medium-density residential* • *Retail and employment centres* • *School* • *Open space* • *Drainage network/basins* *Transport network*
 **(21,000+ dwellings)**	 **(12,000+ dwellings)**	 **(12,000+ dwellings)** **(Inc. Release Area 1 - 3,500+ dwellings)**

1.2 INTRODUCTION

Civille has been engaged by the Proponent to prepare an urban heat assessment support the Appin (Part) Precinct Plan (the precinct plan) and Appin (Part) Precinct Structure Plan (the structure plan).

The precinct and structure plan boundaries are Wilton Road to the east, the Nepean River to the west and Ousedale Creek to the north. Refer to Figure 1 and Table 2 for key attributes of the precinct plan and structure plan area.

The Appin (Part) Precinct Plan zones land for conservation, urban development and infrastructure and establishes the statutory planning framework permitting the delivery of a range of residential typologies, retail, education, business premises, recreation areas, and infrastructure services and provides development standards that development must fulfil. Within the proposed urban development zone, 12,000+ dwellings can be delivered.

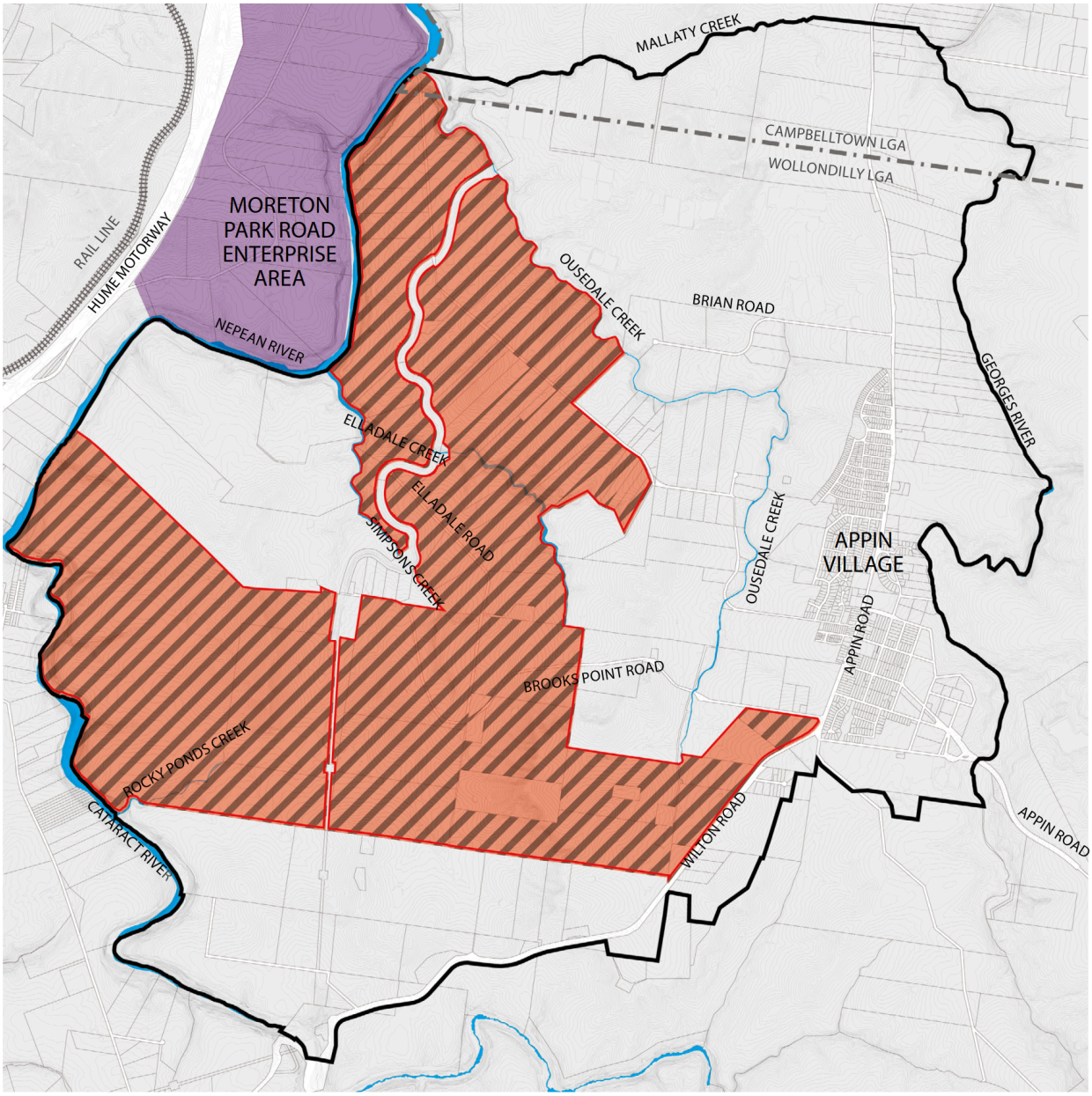
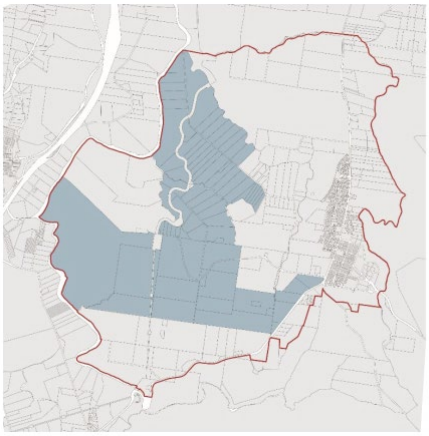


Figure 1: ***Boundary of Appin (Part) Precinct Plan***

Table 2: ***Appin (Part) Precinct – summary of key attributes***

Location		Key Attributes	
Appin (Part) Precinct		**Area**	- Total - 1,378 ha - Walker – 1,248ha - Private Ownership – 94ha
		LGA	Primarily Wollondilly LGA
		Proposed Dwellings	12,000+
		Proposed Population	36,000+

This report summarises the urban heat risks to be considered at the site and proposes a framework, objectives, and potential measures to address urban heat in the future development.

The objectives of the report are:

- To describe he physical context of the development area, in terms of its weather, climate and exposure to heat (Section 2).
- To identify opportunities to address urban heat in the precinct planning and development process (Section 3).
- To describe potential measures that could be incorporated into the development, during the next stages of planning and design to reduce urban heat (Section 4).

This report considers both how the proposed development can be designed to minimise its contribution to the Urban Heat Island effect, as well as how it can be designed to minimise heat-related risks to future residents.

This report proposes potential planning objectives and design measures that could be integrated into later stages in the development process.

The report concludes:

- There are opportunities in the precinct's planning and design to reduce the heat island effect and reduce the impacts of urban heat at a human scale.
- Green, blue, and grey infrastructure all play a role.
- A 40% tree canopy target is recommended for the Appin (Part) Precinct as a whole.
- Appropriate targets for retaining water in the landscape and a cool roof standard should be considered as part of further planning.

The Proposal can be supported in its current form.

2 PHSYICAL CONDITIONS AND HEAT RISKS

Appin's physical conditions mean that urban heat is a risk to future residents, particularly in a changing climate.

2.1 AIR TEMPERATURES AND HOT DAYS

The Appin (Part) Precinct is exposed to both heat and cold. The warmest months are December to February (Figure 2).

The former NSW Office of Environment and Heritage (2014) and the Greater Sydney Commission (2018a) have both defined "hot days" as those where the temperature reaches above 35°C, and the Greater Sydney Commission (2018a) has recommended the number of hot days as a performance measure for addressing urban heat.

Data from the Camden Airport AWS weather station has been used for as a reference for the Appin (Part) Precinct, as this weather station is reasonably close to the site (<20 km) with very similar climatic conditions. Camden Airport AWS has a long time series of data available, including temperature, rainfall, humidity, and wind data.

While average conditions in the area in summer are comfortable, Figure 2 shows that Decile 9 maximum temperatures (i.e., one day in every ten) in December to February exceed 35°C.

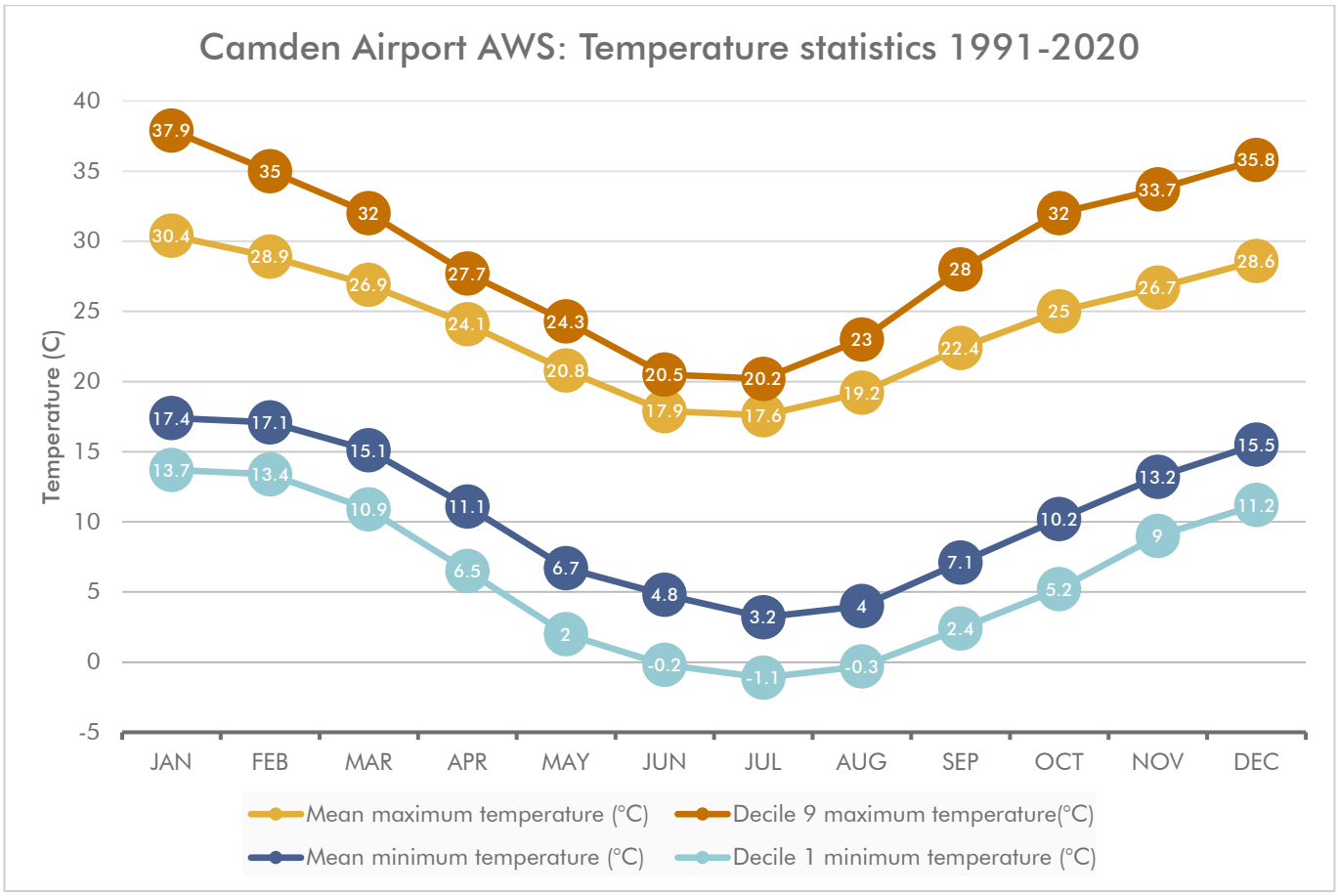


Figure 2: Camden Airport AWS temperature statistics, 1991-2020 (based on data from Australian Bureau of Meteorology)

Based on recent data (1991-2020), as shown in Figure 3, the area experiences an average of 17.1 hot (>35°C) days per year, including 2.9 days where the temperature peaks over 40°C. The number of hot days is expected to increase as the climate changes over the coming decades. Figure 4 shows the projected increase in the number of hot days across Sydney by 2060-79 (NSW OEH 2014). Near the Appin site, the projected increase is 5-20 days.

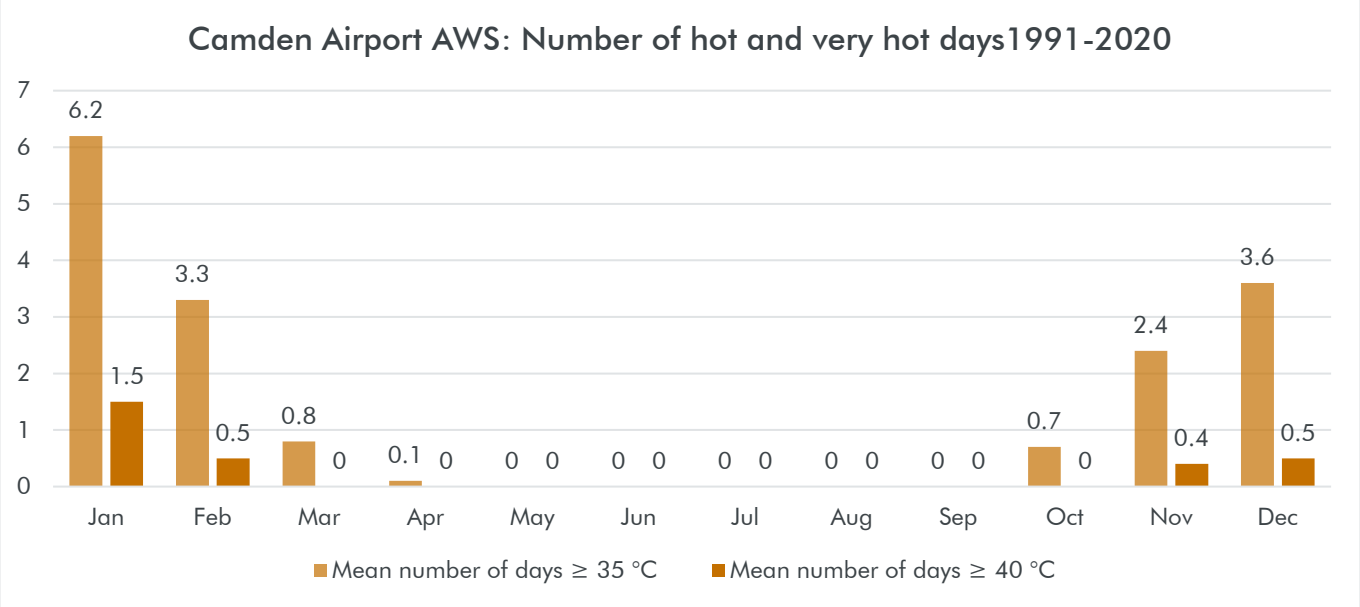


Figure 3: Camden Airport AWS number of hot days, 1991-2020 (based on data from Australian Bureau of Meteorology)

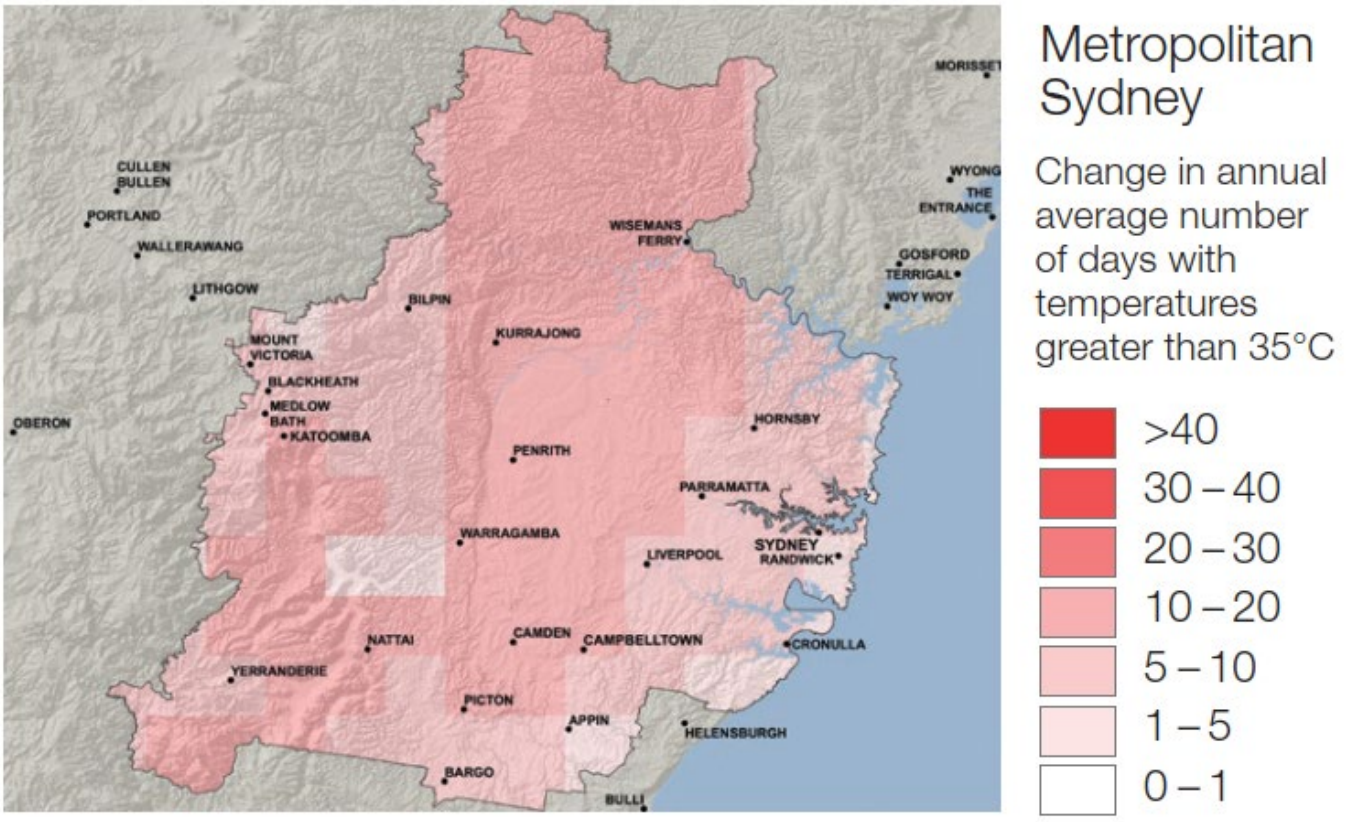


Figure 4: Future (2060–2079) projected changes in the number of days per year with maximum temperatures above 35°C (NSW OEH 2014)

2.2 HUMIDITY AND AIR MOVEMENT

Humidity data for Douglas Park (<5 km from the site) is plotted in Figure 5. This shows that conditions tend to be dry in winter and humid in summer, with humidity sometimes becoming uncomfortable in summer. As humidity increases, evaporative cooling strategies become less effective, but they are still recommended as part of the suite of cooling strategies for the Appin (Part) Precinct, as in Western Sydney, very hot days and heatwaves tend to be relatively dry, and evapotranspiration will be effective at these times.

Breezes are an effective cooling measure in humid conditions. Figure 6 shows that in summer, prevailing breezes tend to be easterly. In the Appin (Part) Precinct, exposure to easterly breezes will help with summer cooling, and this should be considered in the orientation and layout of the development.

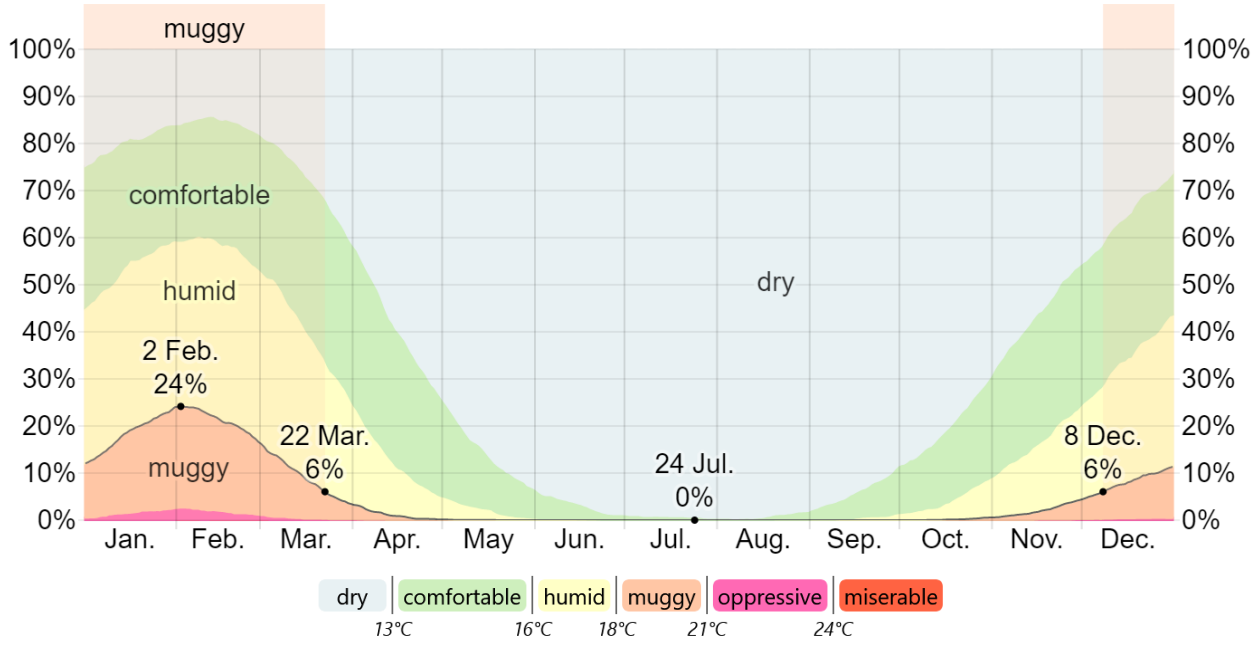


Figure 5: The percentage of time spent at various humidity comfort levels, categorized by dew point. (Source: Weatherspark)

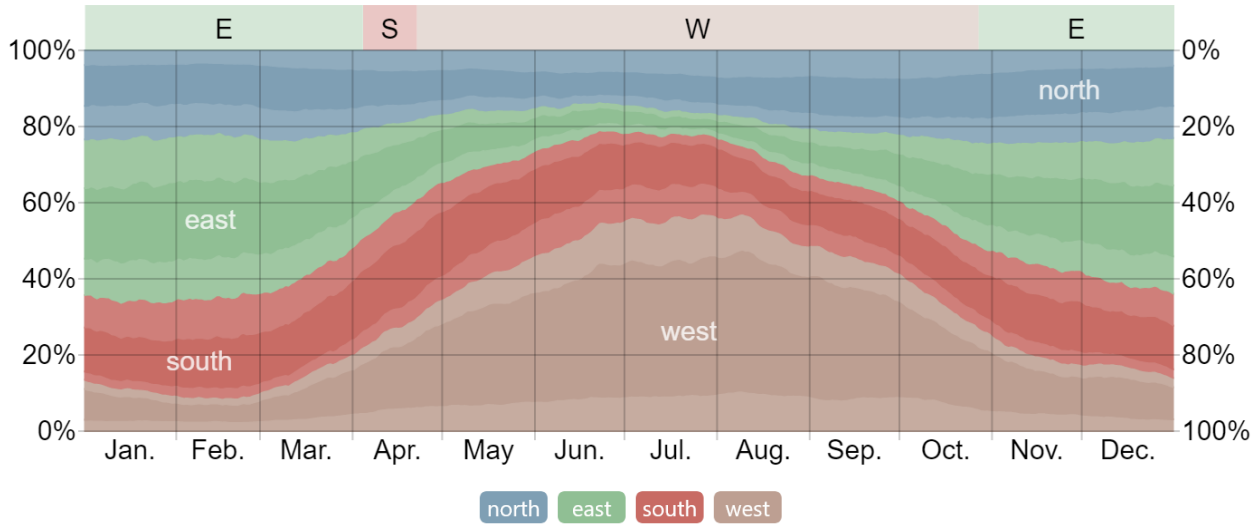


Figure 6: The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.6 km/h. (Source: Weatherspark)

3 OPPORTUNITIES TO ADDRESS HEAT

To improve resilience to urban heat we should plan and design urban areas both to reduce heat at city scale and reduce its impacts at a human scale.

The Western Sydney District Plan (Greater Sydney Commission 2018b) includes a Planning Priority (W20) "Adapting to the impacts of urban and natural hazards and climate change". This delivers on the following objectives:

- Objective 36 People and places adapt to climate change and future shocks and stresses
- Objective 37 Exposure to natural and urban hazards is reduced
- Objective 38 Heatwaves and extreme heat are managed

Actions in the Western Sydney District Plan include #88: "Mitigate the urban heat island effect and reduce vulnerability to extreme heat."

Wollondilly's Local Strategic Planning Statement (Wollondilly Shire Council 2020) identifies urban heat as both a chronic and acute risk in the area. Council aims to "ensure new communities are designed and built to be more resilient" with commitments to:

- "Review and update the DCP to ensure greater certainty of sustainable outcomes for new development"
- "Review the LEP for opportunities to better manage natural and manmade hazards"
- "Work with the Department of Planning, Industry and Environment on delivering sustainable precincts in growth areas."

The Greater Macarthur Growth Area plan (NSW Government 2018) includes as a principle that "precinct planning and the development process must… consider opportunities for green cover, creating open spaces, and permeable and reflective surfaces and heat island effects to avoid increasing urban surface temperatures and effects, especially where there are vulnerable communities."

Addressing heat and its impacts involves working at multiple scales. WSROC's Urban Heat Planning Toolkit (McAuley *et al* 2021) proposes a framework for planning and design for urban heat resilience, which is shown in Figure 7. Two related principles form the starting point of this framework:

3. **Plan and design urban environments to reduce urban heat.** This relates to the city scale and means applying measures to reduce the urban heat island effect, as well as measures to reduce carbon emissions and mitigate climate change.
4. **Plan and design urban environments so that people can adapt to a hotter climate.** This relates to a human scale, and involves both enabling people to survive heatwaves, and to thrive in a hotter climate.

To survive heatwaves, people need homes that remain comfortable during heatwave conditions, therefore reliable energy supplies are important to meet cooling needs. However, homes should also be designed to stay cool enough for residents to survive heatwaves at home, even when power supplies are interrupted. Improved passive thermal performance would also help reduce peak energy demands

To thrive in a hotter climate, people also need to be able to participate in everyday activities such as work, education, and recreation, and to access essential services in safety and comfort, even when conditions are hot. Therefore, non-residential buildings also need to stay cool in hot weather, and outdoor spaces, including streets and parks, need to remain useable. Green and blue infrastructure can both play an important role here, and sustainable water supplies get a special mention in Figure 7 due to the cooling potential that would be unlocked by water being available for irrigation and evaporative cooling at the times when it is most needed.

While all these aspects of urban heat resilience are relevant to Appin, some are covered at national or state level by existing polices and planning instruments, and others are dealt with in larger-scale regional planning.

Table 3 considers where the Appin (Part) Precinct planning and development process could play a role in mitigating the impacts of urban heat. The most significant opportunities are in creating cooler cities and cool outdoor spaces.

Section 4 provides more information on the main opportunities listed in Table 3, including examples.

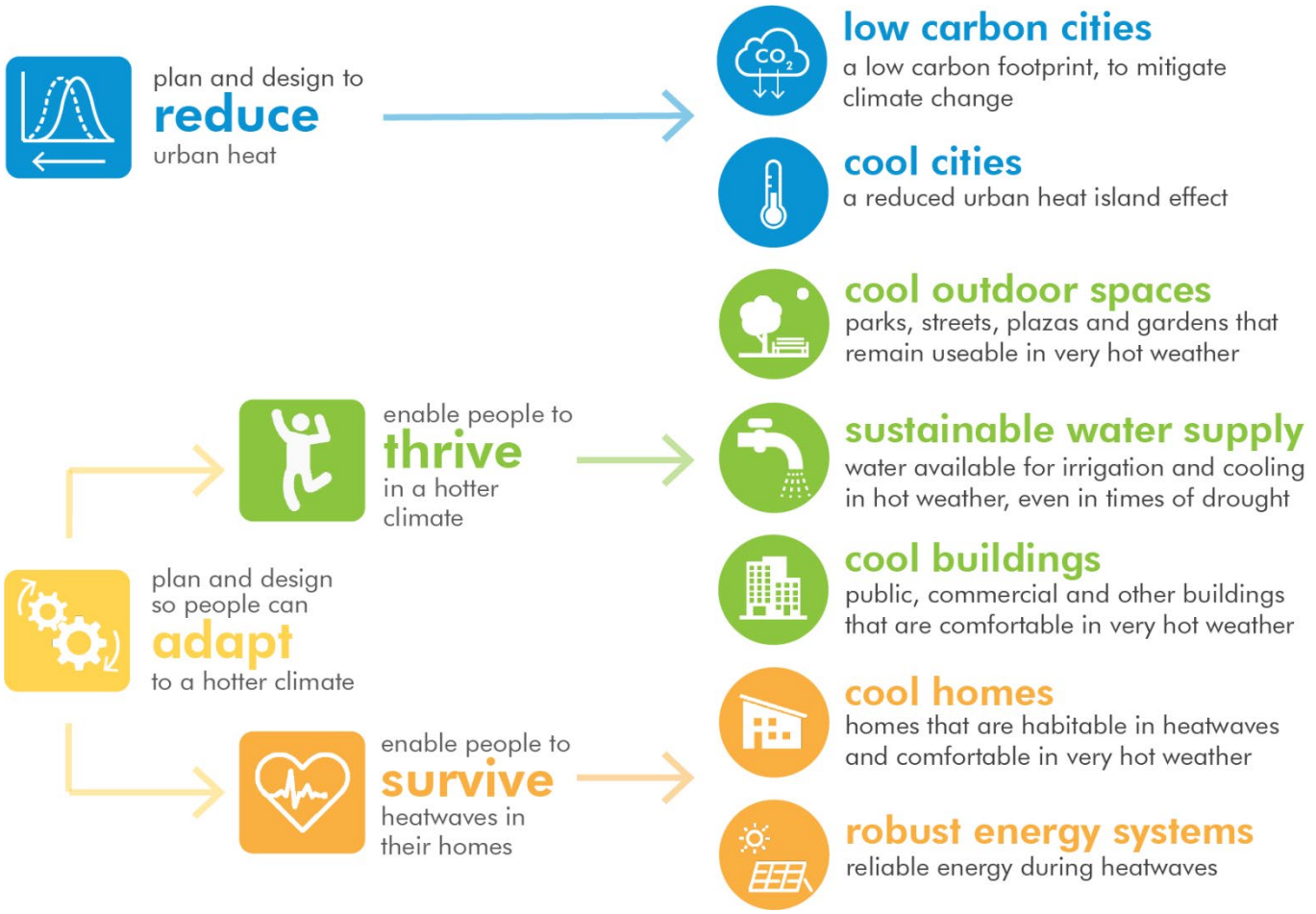


Figure 7: Urban planning and design approaches to reduce urban heat and help people adapt to urban heat (McAuley et al 2021)

Table 3: Addressing each aspect of urban heat resilience

	Aspects covered by national, state and regional policies and plans	Opportunities in the Appin (Part) Precinct planning and development process
Low carbon cities	• National and state policies for carbon emissions and renewable energy. • State based planning for waste management. • Regional transport planning. • Residential energy efficiency is covered by the BASIX SEPP.	• Set energy efficiency benchmarks for non-residential buildings. • Provide infrastructure to support local use of public transport, active transport, and electric vehicles.
Cool cities		• Adopt canopy cover and green cover targets for the precinct. • Adopt a target for the precinct to retain water in the landscape. • Set a cool roof benchmark. • Encourage the use of 'cool paving' materials, with high thermal emittance, and/or permeability.
Cool outdoor spaces		• Consider orientation of site features to catch prevailing breezes and maximise shade in summer. • Set benchmarks for canopy cover and green cover in streets, parks, and on private land. • Prioritise canopy cover where it will shade paved areas and building walls, particularly northern and western walls. Where canopy cover is impractical, shade structures can also be effective. • Encourage irrigation or passive irrigation of trees and other vegetation. • Encourage the use of WSUD features that retain water in the landscape. • Set benchmarks for shade cover in key places such as parks, town centres, and transport nodes. • Provide outdoor 'cool zones' including targeted measures such as additional shade and evaporative cooling. • Prioritise all the above where people are most likely to be present and active outdoors, particularly vulnerable people.
Sustainable water supply	• Regional planning for water servicing • Residential water efficiency (and alternative supplies) is covered by the BASIX SEPP.	• Encourage alternative water supplies for non-residential development
Cool buildings	• The National Construction Code includes relatively stringent passive conditioning requirements for non-residential buildings (McAuley *et al* 2021)	
Cool homes	• Thermal performance of residential buildings is covered by the BASIX SEPP.	
Robust energy systems	• Regional planning for energy supply	

4 POTENTIAL MEASURES FOR APPIN

Green, blue and grey infrastructure can all play a role in mitigating the impacts of urban heat.

4.1 GREEN INFRASTRUCTURE

Relevant existing plans are clear that green infrastructure, particularly canopy cover, should play an important role in reducing the impacts of heat. Several plans include specific canopy cover targets.

The Western Sydney District Plan (Greater Sydney Commission 2018b) includes an action (#73) focused on tree canopy, to help support urban heat mitigation: "Expand urban tree canopy in the public realm." The District Plan also mentions that the NSW Government has set a target to increase tree canopy cover across Greater Sydney to 40 per cent.

Wollondilly's Local Strategic Planning Statement (Wollondilly Shire Council 2020) also prioritises tree canopy, with commitments to develop an urban tree canopy strategy, review and revise provisions related to trees in the DCP and develop a significant tree register. It also mentions a canopy cover target of 40%.

The Greater Macarthur Growth Area plan (NSW Government 2018) also positions tree canopy as playing a role in addressing urban heat. It states that "precinct planning must… integrate Green Plans that will underpin the neighbourhood structure and identify how a 40% tree canopy cover, green links, tree-lined streets and shaded environments can be achieved."

Therefore, it would be appropriate to adopt a tree canopy cover target of 40% for the Appin (Part) Precinct.

Certain plans for other major precincts in Western Sydney have made a commitment to the same canopy target, for example:

- The Wilton DCP (NSW Government 2021a) includes a requirement "Development is to demonstrate alignment with the Neighbourhood Plan strategy to deliver 40% tree canopy."
- The Aerotropolis Precinct Plan (NSW Government 2022) includes an objective (BGO2) "Achieve the targets in the Region Plan of 40% tree canopy cover across the Aerotropolis by 2036."

Planning for tree canopy cover will be subject to requirements for bushfire protection set out in the NSW Rural Fire Services 'Planning for Bushfire Protection' (NSW Rural Fire Service, 2019, pp. 34-37). This is because a large portion of the Appin (Part) Precinct is currently classified as bushfire prone land (NSW Department of Planning and Environment, 2022). Bushfire protection requirements are likely to preclude canopy cover in some parts of the precinct.

To achieve the 40% canopy cover target for the precinct, conservation and urban greening areas will make a significant contribution, however there will also likely need to be significant tree planting within the public domain including within parks and streetscapes. Canopy cover in parks and streetscapes is also important to address the impacts of heat at a microclimate level, providing shade and creating cool outdoor spaces where people are present and active in the urban environment.

Trees should be selected for parks and streetscapes that maximise canopy cover. This should include a mix of tree species including:

- Some fast-growing species that will help establish reasonable canopy cover relatively quickly.
- Some species that grow to a large size (e.g. >10m height and >8m canopy spread), which are likely to make a greater contribution to long-term canopy cover.
- Where possible, select species with reasonably dense canopy cover.
- Where possible, select species likely to thrive in future climatic conditions.

A mix of native and exotic species is likely to be most appropriate to meet this range of objectives.

A total green cover target should also be considered in addition to the canopy target. This would recognise the role of all vegetation in reducing the UHI effect.

To better address heat impacts at a human scale, precinct-wide targets should also be supported with more specific benchmarks for canopy cover and total green cover in specific parts of the development including streets, parks, and on private land. This approach has been adopted in the Wilton DCP (NSW Government 2021a), which includes specific requirements for trees on residential lots.

Planning principles and design guidelines should also prioritise canopy cover where it will be most effective at keeping people cool, including:

- Where it will shade paved areas and building walls, particularly north and west-facing walls
- Where it will shade places that people are more likely to be present and active outdoors, including parks, town centres, and transport nodes.

4.2 BLUE INFRASTRUCTURE

Existing planning documents also indicate an expectation that water should play a role in mitigating urban heat, particularly the concept of 'retaining water in the landscape'.

The Western Sydney District Plan (Greater Sydney Commission 2018b) says: "Retaining more water in the landscape and integrating waterways in the design of new communities will help create a greener and cool city. Water-play features and connections with water will become essential elements of urban areas, while green walls, green roofs and initiatives such as rain gardens will help cool urban environments."

The Greater Macarthur Growth Area plan (NSW Government 2018) says: "New buildings… will efficiently use energy and water, including reuse for non-potable purposes, evaporative cooling, water gardens…"

The idea of retaining more water in the landscape relates to multiple objectives, including reducing stormwater runoff and protecting natural waterways.

Stormwater treatment systems (e.g. wetlands/bioretention basins) will likely be required to meet water sensitive urban design (WSUD) objectives for the development. These provide an opportunity to contribute to urban heat mitigation. Where natural treatment systems are proposed as part of the WSUD strategy for Appin, vegetated stormwater treatment systems should be designed to retain water for passive irrigation, infiltration, and evapotranspiration. Wetlands and saturated zone bioretention systems are preferable to fully drained systems.

Planning for Appin should also consider the potential to incorporate passive irrigation into the design of street trees and other vegetation. For example, the draft Aerotropolis Phase 2 DCP proposes passively irrigated street trees as shown in Figure 8 below.

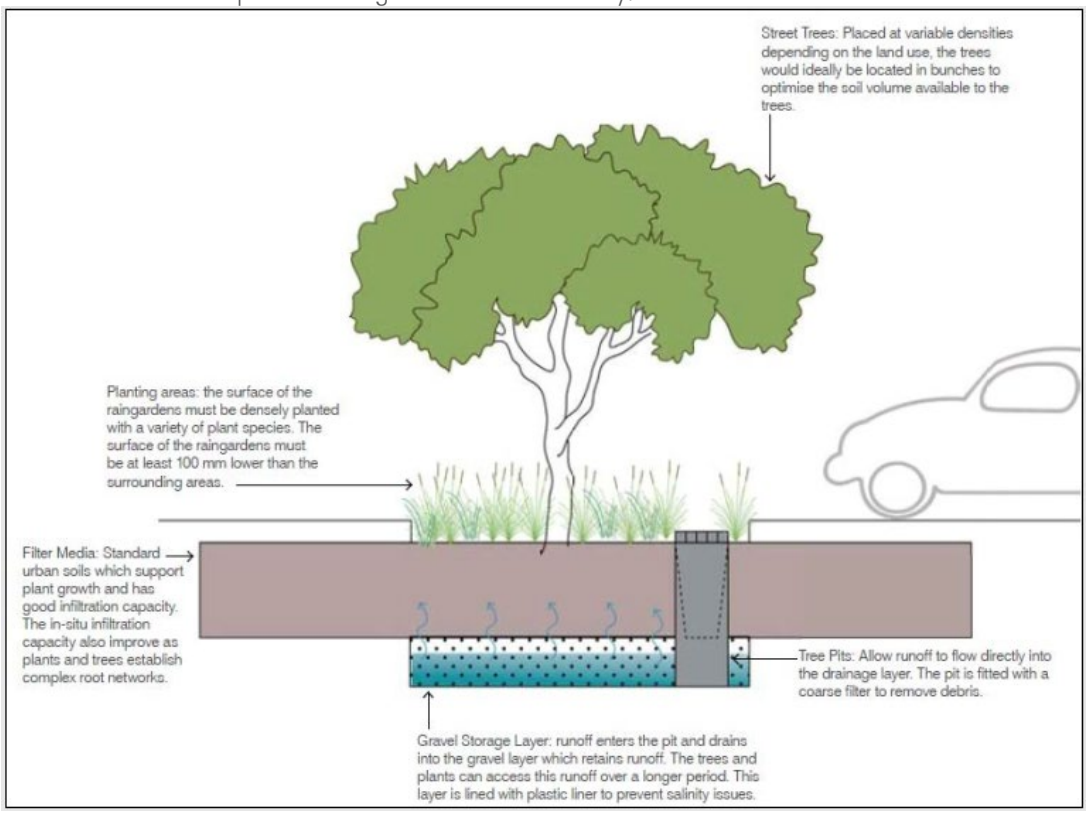


Figure 8: Passively irrigated street tree proposed in the Aerotropolis Phase 2 DCP (NSW Government 2021b)

The WSUD strategy should consider the site-wide potential to retain water and reduce runoff. Flow objectives, a site-wide runoff reduction target or a commitment to passive irrigation over a certain area should be considered to formalise a commitment to retain water in the landscape. For example, the Aerotropolis Precinct Plan (NSW Government 2022) includes stormwater flow targets.

In parks, town centres and transit hubs, irrigated landscapes and water features would also help reduce temperatures.

4.3 GREY INFRASTRUCTURE

COOL ROOFS

Cool roofs are a simple, low- or no-cost measure easily integrated into new urban development.

The Greater Macarthur Growth Area plan (NSW Government 2018) states that "External colours and materials should be natural, muted tones of green, brown, blue and grey. White, light-coloured, red, green, yellow or orange roofs and walls should be discouraged." This is an effort to integrate the urban form with natural surroundings but may, by incidence, have negative effects on urban heat by discouraging white or light-coloured roofing.

To meet this design intent while reducing urban heat island effects, roofing materials at the Appin (Part) Precinct should be selected for their thermal performance. Cool roofs can be specified in terms of their Solar Reflectance Index (SRI) or solar absorptance (SA). While light-coloured roofs (including lighter tones of green, brown, blue, and grey) would be likely to rate well by either measure, darker-toned colours with special surface coatings can also meet cool roof standards.

While the use of natural colours with special surface coatings could assist with visual integration of the urban form with the surrounding landscape, light coloured or white roofing should not be excluded from consideration altogether, as it offers a cost-effective option to achieve high SRI/low SA. This could be particularly important for low density residential areas where home buyers are sensitive to building costs. For example, consider light-coloured roofing for areas that will not be in direct proximity to surrounding natural landscapes in the Structure Plan.

Note that the Greater Macarthur Growth Area plan (NSW Government 2018) also encourages green walls and green roofs, however these are not likely to be appropriate for many buildings at the Appin (Part) Precinct due to their construction and maintenance costs. Where cost is not prohibitive and such options are more feasible, such as for town centres or higher density development, green roofs and walls should be encouraged, as in the Growth Area Plan.

COOL OR PERMEABLE PAVING

Conventional paving materials can significantly contribute to urban heat because they absorb, store and release heat back to the built environment. Cool pavements reflect solar radiation, conduct and store less heat.

Asphalt makes up the majority of pavement throughout the development. A lighter coloured asphalt would reduce heat absorption and reduce the UHI.

A range of different products and materials can be used to enhance the thermal performance of ordinary paving materials:

- Paving with light-coloured aggregates, pigments and binders.
- Paving with light-coloured coatings (e.g. cementitious coating, elastomeric coating).
- Materials with a high emissivity rating, meaning they will be less prone to embodying heat.

Permeable paving (including porous asphalt, porous concrete, block pavements, reinforced grass pavements) can also reduce heat via evapotranspiration, providing it is installed on a subgrade with the capacity for infiltration or temporary storage of water below the pavement.

Note, when using lighter coloured materials for paving, take care to avoid unwanted glare. In areas where glare could be an issue, avoid high albedo, white or very light surfaces.

SHADE STRUCTURES

Shade structures should be used over playgrounds, picnic tables, bus stops and other places where people gather, to improve comfort and safety in hot conditions.

5 CONCLUSIONS

Urban heat is a risk for the future Appin community, however the precinct can be planned and designed to minimise its impact on the urban heat island and for improved heat resilience.

New development at Appin is likely to be exposed to increasing heat as the climate changes. An increasing number of hot days (>35°C) are expected to occur in the coming decades.

There are opportunities in the precinct's planning and design to reduce the heat island effect and reduce the impacts of urban heat at a human scale. Green, blue, and grey infrastructure all play a role, including:

- Canopy cover and green cover: a 40% tree canopy target is recommended for the precinct. Where trees are not feasible, other vegetation can also play a cooling role.
- Water: irrigated landscapes, passive irrigation. WSUD, water play elements and water features can all play a cooling role. A site-wide target for runoff reduction, passively irrigated areas and creation of water bodies would formalise the objective to retain water in the landscape.
- Cool roofs: cool roofs are a simple measure that should be applied wherever possible. Adopt a minimum SRI/maximum SA value for roofs and consider light coloured roofing.
- Cool paving: use light coloured paving and permeable paving where appropriate, to reduce heat absorption and re-radiation.
- Shade structures can also play a cooling role.

6 REFERENCES

Greater Sydney Commission (2018a) A Metropolis of Three Cities. Updated March 2018.

Greater Sydney Commission (2018b) Western City District Plan. March 2018.

McAuley A, Osmond P, Bartesaghi-Koc C, Stoller P (2021) Urban Heat Planning Toolkit. WSROC, NSW.

NSW Government (2018) Greater Macarthur 2040: An interim plan for the Greater Macarthur Growth Area. NSW Department of Planning and Environment, November.

NSW Government (2021a) Wilton Growth Area Development Control Plan. https://www.planningportal.nsw.gov.au/draftplans/under-consideration/draft-wilton-growth-area-development-control-plan-2019

NSW Government (2021b) Draft Western Sydney Aerotropolis Development Control Plan – Phase 2. https://www.planning.nsw.gov.au/-/media/Files/DPE/Factsheets-and-faqs/Plans-for-your-area/Draft-Western-Sydney-Aerotropolis-Control-Plan-Phase-two.pdf?la=en

NSW Government (2022) Aerotropolis Precinct Plan. https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/Plans-for-your-area/Western-Sydney-Aerotropolis-Precinct-Plan-March-2022-final.pdf?la=en

NSW Government (2022) E-planning Spatial Viewer. https://www.planningportal.nsw.gov.au/spatialviewer/

NSW Office of Environment and Heritage (2014) Metropolitan Sydney climate change snapshot, 16 p.

NSW Rural Fire Service (2019) Planning for Bushfire Protection, A guide for councils, planners, fire authorities and developers, p34-37

Wollondilly Shire Council (2020) Wollondilly 2040 Local Strategic Planning Statement, March 2020.