CANTERBURY BANKSTOWN

Best Practice Research

Open Spaces in City Centres

Solar Amenity Controls

Final - 13th September 2019

Bankstown City Gardens

Contents

Executive Summary

Executive Summary

CBCity is on a journey to reshaping the role and character of its centres, establishing Bankstown and Campsie as key strategic centres in Sydney and facilitating sensible growth in other local centres. With increasing urban densities, it is crucial that the quality, quantity and amenity of the public open spaces in the City centres are protected and enhanced to create places where people want to be and where nature can thrive. A key consideration for achieving sustainable and liveable places, is the provision of open spaces that receive sufficient sunlight throughout the year to support people's wellbeing, turf and plant growth. To achieve this goal, it is important to develop an evidence-based sun protection control framework for open spaces to guide the sustainable growth of our city centres. Such policy framework has not yet been developed by CBCity.

This research, therefore, has been conducted to identify best practice solar amenity controls for open spaces in city centres, providing analysis, evidence and recommendations to inform CBCity's policy framework and the decision-making process. The chapter on Solar Amenity Controls analyses and evaluates a range of controls for maintaining sunlight to main parks in city centres and on urban renewal areas that have been adopted by different Councils in Australia and New Zealand. The chapter on Nature, Health and People's Wellbeing provides a brief overview of key research findings that link the amount of sunlight with the durability and development of turf surfaces, flowering plants and tree growth, as well as research findings on the human health benefits of sunlight and natural environment exposure.

The report concludes that sunlight control is **best measured on the winter solstice**. Best practice policies have a clear objective, an easy to follow metric and **allow for 4 to 5 hours of uninterrupted sunlight** on the winter solstice to either a minimum of 50 percent of the total park area or for 100% of the active zones of the park (containing turf surfaces and soft landscaping). **These controls allow sensible development to occur on lots near parks while maintaining adequate standards of amenity to the parks**, thus achieving a balanced approach between public benefit, amenity, development and urban densification. The controls evaluated as 'poor' in this research require less than 4 hours of uninterrupted sunlight (generally 2 hours only) on the winter solstice, or 1 hour of uninterrupted sunlight within a period of 4 hours on the winter solstice, or they protect sunlight in equinoxes or summer solstice.

The research on the effects of sunlight on nature and ecosystems shows that maximising uninterrupted sun exposure in winter is critical as **turf requires at least 5 hours of sunlight in winter to thrive, while flowering plants and trees need at least 4 hours to grow properly.** The effects of not enough sun include constant replacement of turf, undesirable phototropism of trees and plants, moss and lichen growth and a lack of plant diversity.

For these reasons, it is recommended that the following steps be undertaken:

1. Adopt a solar amenity policy for Paul Keating Park and Bankstown Court House Reserve.
2. Develop an evidence-based sun protection control framework for open spaces to guide the sustainable growth of CBCity's centres.
3. Expand evidence-based research on solar amenity controls to pedestrian streets, other important streets, urban plazas, etc. to ensure sun protection on other key open spaces in the City centres.

These matters are further discussed in Recommendations on Pages 23 and 24

Paul Keating Park

Solar Amenity Controls

Methodology

The methodology for the research on solar amenity controls can be understood in three steps:

1. Literature Review & Data Collection

CBCity has reviewed a range of solar amenity controls for parks in city centres and urban renewal areas of comparable scale to CBCity's existing and future context, both locally and internationally. Planning policies for cities such as London, New York and Copenhagen were investigated, however it became apparent that due to the different climates, latitudes and planning systems in these cities, they were not comparable to CBCity and the NSW Planning System. As such, controls from the City of Sydney, the City of Melbourne, Auckland City Council, Burwood Council, North Sydney Council, Willoughby City Council, Gold Coast City Council, Parramatta Council and Brisbane City Council were deemed relevant.

2. Data Analysis & Comparative Analysis

The controls for the above-mentioned Councils were further analysed to narrow down to the most relevant controls for the CBCity's context. The analysis of each control is presented in mapping and table format, providing a brief summary and an assessment of the pros and cons for each control. Subsequently, CBCity conducted interviews with key council staff in planning and urban design departments to better understand the background, rationale and objectives for the controls and to gather information about their own views, expectations and levels of satisfaction with the controls. Councils with solar amenity controls between equinoxes as opposed to winter solstice were asked for the reasoning behind the decision to adopt such controls. These interviews provided a greater insight into other council's objectives and priorities for their green open spaces and assisted the evaluation and comparison of each control to inform the recommendations in this report. A summary of the interviews is provided on the following pages alongside a table and aerial image for each control. The images were sourced from Nearmaps. Measurement of areas are approximate.

A comparative table for all the controls considered in the literature review and data collection can be found on page 16, providing a clear way to compare the success and relevance of each control.

3. Evaluation

Each control has been evaluated and rated as either 'best practice', 'adequate' or 'poor' in accordance with the following definitions:

Controls identified as **'best practice'** require a minimum of 4 or 5 hours of uninterrupted sunlight on the winter solstice (21 June) for at least 50% of the total park area or for 100% of the active zones of the park (containing turf surfaces and soft landscaping). This is because:

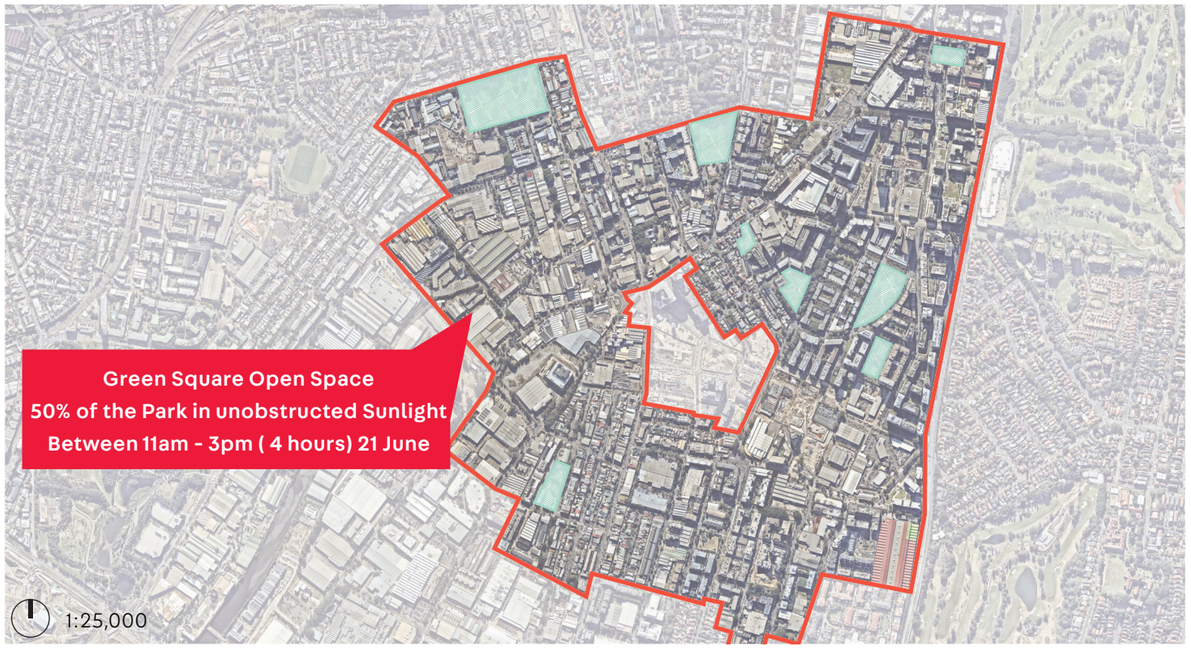
- most councils adopting such controls were satisfied with the amenity of the parks as a result of the controls;
- common knowledge and research on the effects of sunlight on nature and ecosystems indicate that 4 hours of uninterrupted sunlight in winter is the absolute minimum (5 to 6 hours is the recommended amount) required to support the healthy growth of turf, flowering plants and trees, to reduce turf and plant maintenance and to allow greater plant diversity (discussed further on page 18);
- research on the effects of sunlight and nature on people's wellbeing indicate that exposure to natural environments improves people's physical, mental and social wellbeing. Without adequate sunlight, natural environments cannot thrive in higher density urban areas. Also, moderate exposure to sunlight improves people's mental and physical health (discussed further on page 19); and
- the control allows sensible development to occur on lots near parks while maintaining adequate standards of amenity to the parks, thus achieving a balanced approach between public benefit, amenity, development and urban intensification. It puts people, nature and spaces first, then buildings and developments.

Best Practice Adequate Poor

Controls identified as **'adequate'** were put in place to prohibit any additional overshadowing on parks on the winter solstice. These are regarded as retroactive controls because higher density developments near the parks were permitted before solar amenity controls were put in place, creating overshadowing impact on the parks. They are considered adequate as it maintains existing sunlight conditions, but are not necessarily best practice or based on evidence as many of the parks receive only 3 hours of sunlight on the winter solstice. Controls that prohibit any additional overshadowing on parks are not deemed appropriate for many parks in CBCity centres not yet subject to urban renewal and densification. This is because many parks receive sunlight in winter in excess of 6 hours for 80% to 100% of the total park area. Therefore, maintaining current sunlight conditions to some of these parks would inhibit the development potential of surrounding lots on key strategic centres, thus hindering economic prosperity of our centres.

Controls identified as **'poor'** require less than 4 hours of uninterrupted sunlight (generally 2 hours only) on the winter solstice, or 1 hour of uninterrupted sunlight for a period of 4 hours on the winter solstice, or protect sunlight on equinoxes or summer solstice. They are deemed poor for the CBCity context as it would significantly impact adversely on the City's natural environment and people's wellbeing and behaviour in parks. These controls are also contrary to the findings regarding the effects of sunlight on nature and ecosystems and the effects of sunlight and nature on people's wellbeing. Many of these controls were developed to allow urban intensification, but adversely impacted the amenity of the public domain. These controls put buildings and developments first, before successful spaces.

City Of Sydney



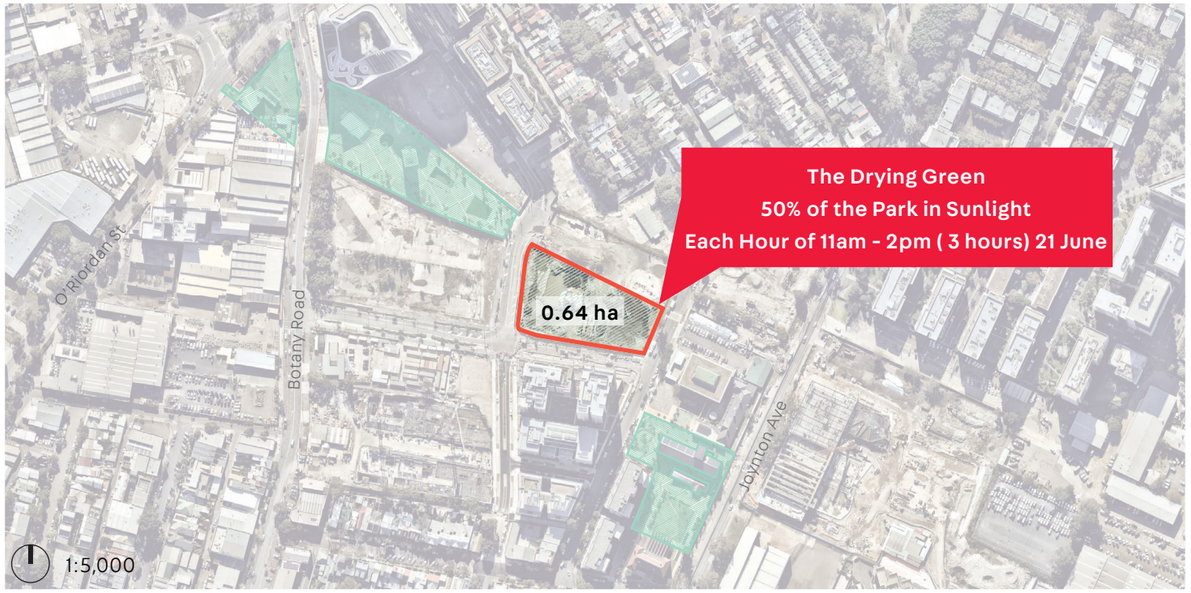
South Sydney DCP 1997 - Green Square Open Space (excludes Town Centre)

Policy	South Sydney DCP 1997 - Part G: Urban Design - Special Precinct 9: 3.1.2 Open Space
Objective	To ensure the design of open space is of a high quality (safe, diverse, visually attractive, environmentally sustainable, accessible, relatively easy to manage), provides a variety of uses and allows flexibility of uses over time according to community needs
Control	"For non-linear public open space areas, 50% of the total area of the park should be in sunlight between 11am and 3pm [4 hours], in mid-winter."
Pros	The control for 4 hours of uninterrupted sunlight in midwinter • Was determined through evidence-based research and is an easy to measure metric • Reduces requirement for turf replacement, allows for flowering plants to survive through winter and allows the proper growth of a great variety of tree species • Promotes health and wellbeing of users and allows for adequate thermal gain for solar panels
Cons	• Ideally, a greater percentage of the area of the park should receive sunlight for a longer period of time during winter
Conclusion	● Best Practice ○ Adequate ○ Poor

What does City of Sydney have to say?

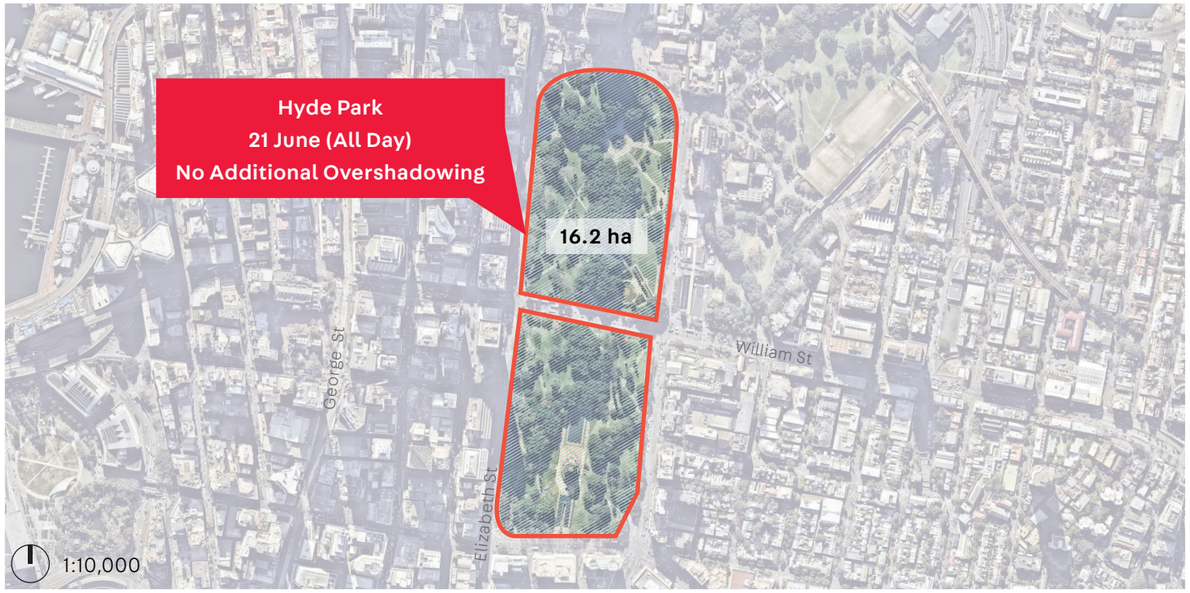
Summary of interview with Urban Design Coordinator at City of Sydney

- The Drying Green solar access control is a compromised solution and will provide inadequate solar access to the park. It is a weakened version of the original solar access control adopted in the South Sydney DCP 1997 – Part G: Urban Design Special Precinct, as summarised in the 'Green Square Open Space Table.' The Drying Green control has never been used again in other locations within the CoS LGA.
- CoS owns land adjacent to the park and has decided not to develop the land to its maximum building height and FSR controls, partly so as to increase solar access to the Drying Green.
- CoS has found that in many high density environments, heavily utilised turf needs replacing every year if it doesn't receive four hours of direct sunlight in midwinter. To successfully replace turf the area should be out of use for up to 3 months. The Drying Green solar access control does not require four hours of direct sunlight and hence the turf may need to be replaced annually and parts of the park would have to be closed for several months each year.
- Four hours of direct sunlight in midwinter is required to grow many species of trees. The Drying Green solar access control does not require four hours of direct sunlight to any part of the park, and hence the selection of trees that could be planted is limited.
- As of June 2019, The Drying Green and the developments surrounding the park are not complete, so post-construction evaluation has not yet been undertaken.
- CoS suggested that the South Sydney DCP 1997 solar control is a much better control. However, it does not provide certainty and can result in inequitable development outcomes. They recommended the solar control be enforced through sun access planes. Defining street wall heights and sun access planes is very effective in ensuring equitable development outcomes, but care must be taken to ensure that the space will achieve reasonable sunlight (Street wall heights need to be tested).
- Hyde Park is a large park surrounded by buildings with well-defined street walls and maximum permissible sun access planes. The method of sun access planes is effective for ensuring no additional overshadowing to the park. However, this is a site specific control that works with large parks and is not necessarily transferable to other public spaces.



The Drying Green, Green Square Town Centre

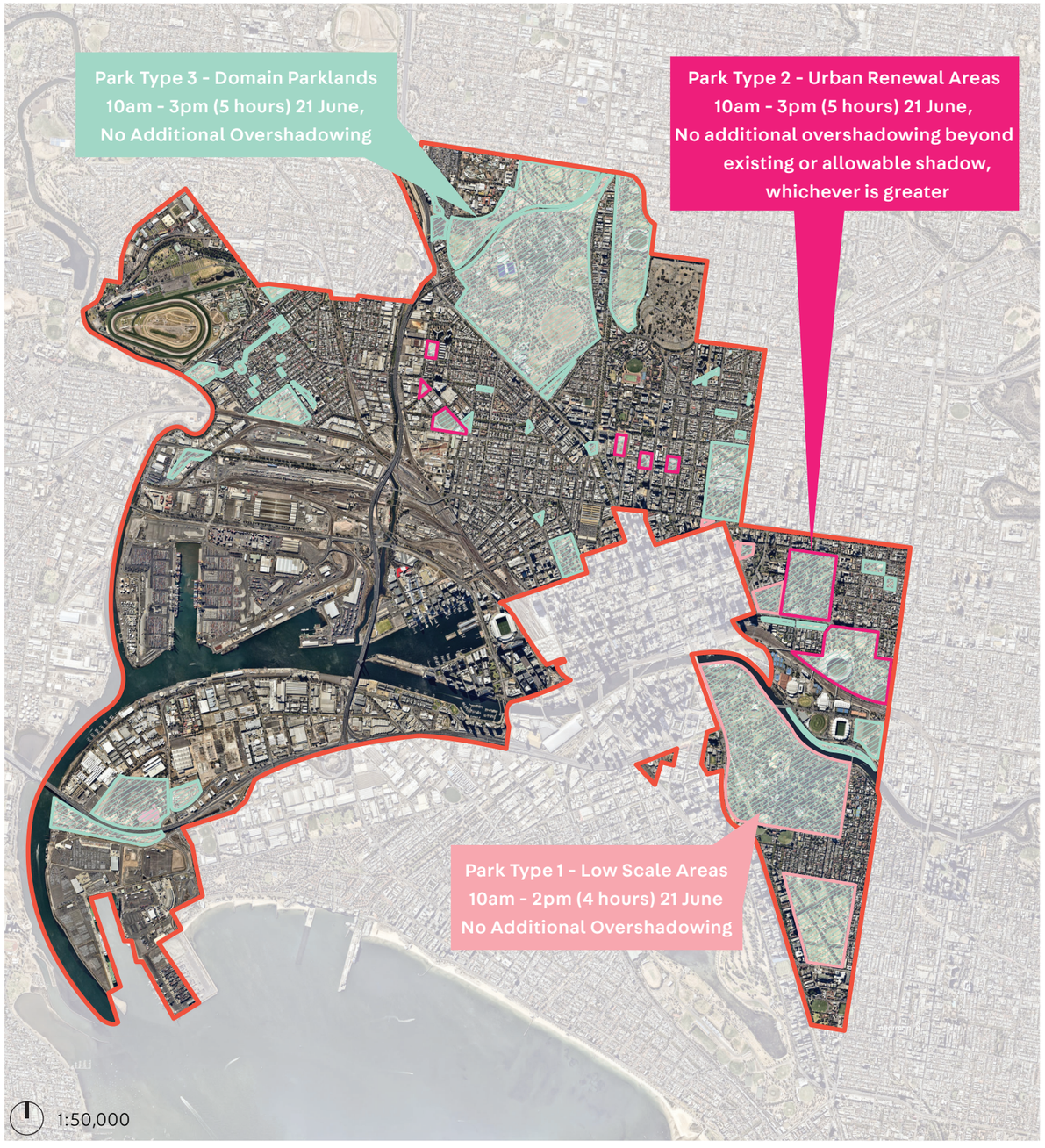
Policy	Green Square Town Centre DCP 2012 - GSTC 3.1.1 The Drying Green
Objective	Provide a primary green space in the town centre that provides primarily soft landscaping and deep soil planting.
Control	Achieve direct sunlight each hour between 11am and 2pm on June 21 for at least 50% of the park.
Pros	• Easy to measure
Cons	• The control is a weakened version of the South Sydney DCP 1997. The control requires 50% of the park to receive sunlight for each hour, rather than 4 hours of uninterrupted sunlight to 50% of the park. • Driven by development rather than providing amenity for people & nature. • Replacement of turf is required often • Spindly & sparse tree growth and less flowering plants • Impact on people's wellbeing and thermal comfort in winter
Conclusion	○ Best Practice ○ Adequate ● Poor



Hyde Park

Policy	CoS LEP 2012 Clause 6.17 & 6.18 & Sun Access Protection Map 'SAP_015', 'SAP_014'
Objective	Ensure no additional overshadowing.
Control	Sun Access Plane Maps with Height Limits for Adjacent Buildings
Pros	• Clear metric for compliance • Ensures no additional overshadowing
Cons	• The control is retroactive as development was previously allowed, which created overshadowing. • A site specific method of controlling sunlight access means that this method may not be applicable to other sites
Conclusion	○ Best Practice ● Adequate ○ Poor

Melbourne City Council



Outer Melbourne City Public Spaces

Policy	Melbourne Planning Scheme Amendment C278 - currently on public exhibition
Objective	To future proof solar amenity in public spaces to ensure a variety of activities can occur throughout the day for all user groups in mid-winter
Control	Mandatory Compliance (most of Melbourne's planning scheme is discretionary) Park Type 1 - Low Scale Areas: 10am - 2pm (4 hours) no additional overshadowing This control has been defined by the existing development: "The orientation of existing street grids has a direct effect on the amount of sunlight reaching each park throughout the day...After 2pm, the shadows from significant buildings in Southbank begin to fall across these parks." Park Type 2 - Urban Renewal Areas: 10am - 3pm (5 hours) no additional overshadowing beyond existing shadow or allowable shadow, whichever is greater. Allowable shadow is shadow that would be created if a street wall was built to the current development controls. Park Type 3 - Domain Parklands: 10am - 3pm (5 hours) no additional overshadowing
Pros	• Protects sun access to parks in urban renewal areas - people & nature come first • A 5 hour control is the optimal amount of sun needed to grow turf and is better than the absolute minimum of 4 hours that has become the status quo in many areas. • A site specific control that ensures amenity can be achieved • Allows for many different park users and activities throughout the day • Ensures turf, plants & trees get sun in winter, protecting the current levels of amenity • Mandatory control ensures compliance • Park type 2 accounts for development controls so as to not limit development in these areas
Cons	• Currently on public exhibition so control has not yet been finalised
Conclusion	● Best Practice ○ Adequate ○ Poor

Diagram to explain 'balanced' approach for solar amenity in Melbourne. Excerpt from 'Sunlight access to public parks modeling analysis report' prepared by Hoddle & Co for City of Melbourne February 2018.

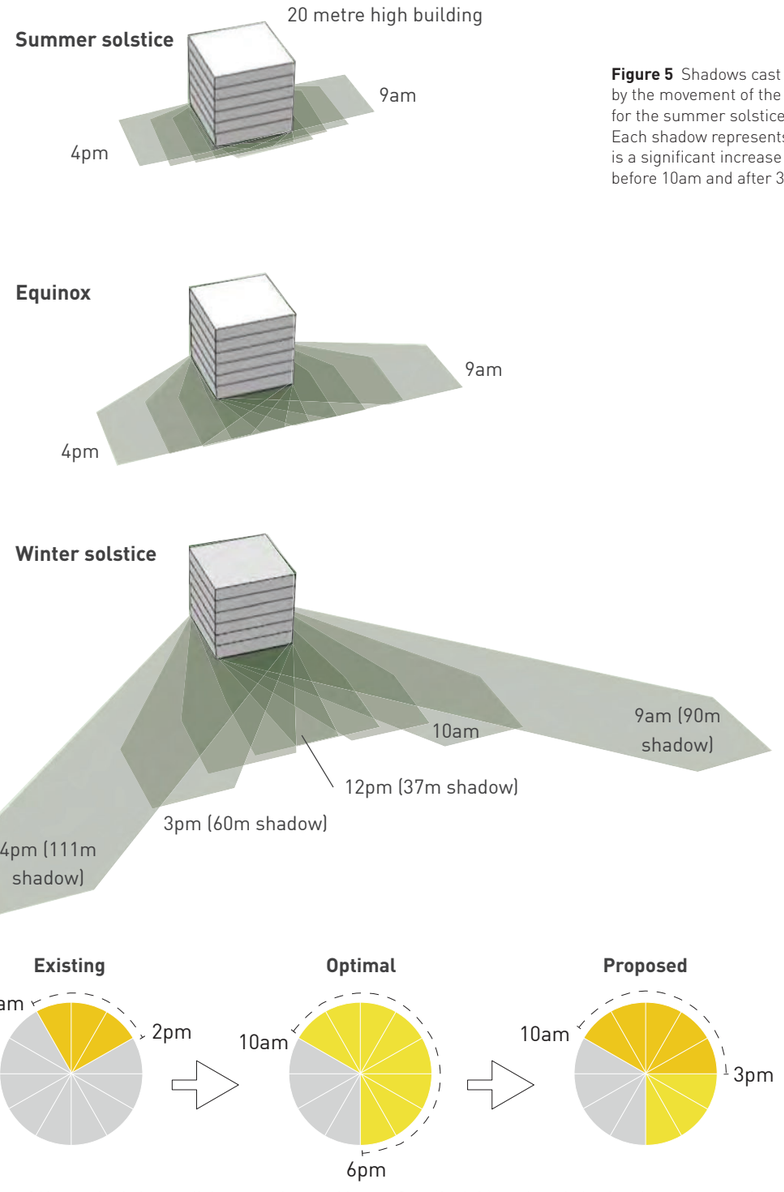


Figure 5 Shadows cast for a 20 metre high building by the movement of the sun between 9am and 4pm for the summer solstice, equinox and winter solstice. Each shadow represents a one hour interval. There is a significant increase in shadow length in winter before 10am and after 3pm.

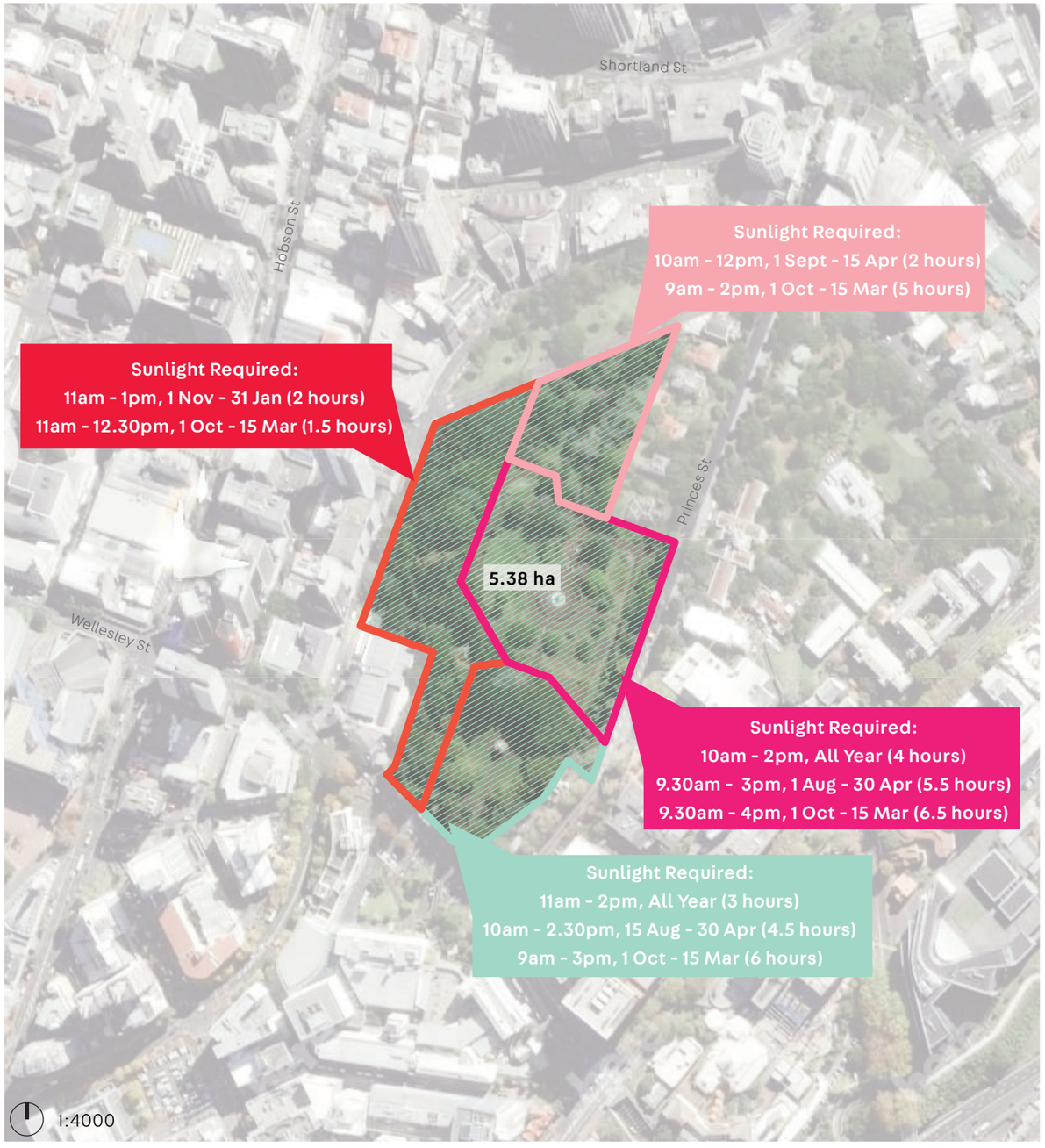
Figure 6 Hours of existing sunlight protection are 11am to 2pm (far left); peak periods of park usage space from 10am to 6pm (centre); taking into account the potential impacts on development capacity, a balanced approach which provides winter sunlight access between 10am and 3pm is proposed.

What does Melbourne Council have to say?

Summary of interview with Head of Urban Strategy at Melbourne City Council

- Melbourne Planning Scheme differs from controls in NSW as the controls within the Scheme can be mandatory or discretionary; the majority of the controls are discretionary. Non-compliance with mandatory controls are grounds for refusal of a development. A development that is non-compliant with a discretionary control is assessed against the objectives of the control and is not necessarily grounds for refusal.
- The current controls for solar amenity in public parks outside the city centre are discretionary, with no overshadowing on the Spring Equinox. The control effectively provides no protection for solar access in winter and supports inequity of access to sunlight as mandatory controls are not evenly distributed across the municipality.
- A review of all 157 open spaces and parks in the municipality was undertaken by Hoddle & Co. The study found that the 133 parks in low rise areas will be naturally protected as development controls will not cause overshadowing. However of the 24 parks in growth areas, 14 are vulnerable to overshadowing from future development.
- The study provided several recommendations to the council including, introducing solar amenity protection over the Winter Solstice, a 'flat' control to protect solar amenity in all parks to 'future proof' the amenity from development & creation of park types to ensure development is not limited.
- The proposed C278 amendment will be mandatory in order to future proof solar access to all public parks outside the city centre. This includes several Urban Renewal Areas; current low density areas that will become much denser in the near future.
- Council originally aimed to protect overshadowing between 9am-6pm as it was understood through community consultation that user groups are most active in these times. However, modeling showed that at 9am and 4pm on 21 June the shadows cast by buildings were very long, effectively already overshadowing many parks (as demonstrated in the diagram to the left).
- Protection between 10am and 3pm (5 hours) was decided upon as it was the maximum protection the council could provide without limiting all development. Park Type 1 has a 4 hour protection due to development already overshadowing the park after 2pm.
- The C278 amendment is currently on public exhibition. Depending on the outcomes of the public exhibition, the control could be adopted as is or be amended prior to adoption.

Auckland City Council



Albert Park

Policy	City Centre Master plan p148, Planning Map 4, Central Area District Plan - 14.2A Public Open Space - Concept Plans, Appendix 11 CADP
Objective	Protect the admission of sunlight during the times the park is most intensively used.
Control	Sunlight must reach each zone at specified times and period of the year Limiting building heights nearby, defined by these planes
Pros	• Ensures a minimum of 4 hours of uninterrupted sunlight all year on the active high-use portion of the park with high percentage of turf and flowering growth • Ensures a minimum of 3 hours of uninterrupted sunlight all year on the second most active portion of the park with high percentage of turf and plant growth • This ensures that 40% of the park receive at least 4 hours of sun all year and 56% of the park receive at least 3 hours on sun all year over
Cons	• Requires greater complexity of analysis across the four areas and differing times of year to demonstrate compliance • 3 hours of uninterrupted sunlight on the second most active portion of the park may not be sufficient for plants and turf to thrive in winter
Conclusion	● Best Practice ○ Adequate ○ Poor

What does Auckland City Council have to say?

Summary of interview with Principal Planner at Auckland City Council

- The controls were developed in the 1980s prior to much of the taller development that has occurred in Auckland. These controls have defined much of the built form in Auckland and are now considered sacrosanct; they are deeply embedded in the city centre's planning framework.
- Surveys were undertaken to understand how the public used the parks and squares. The periods of use during the year differ for each park or square. Some parks and squares have year-round use and therefore justify protection. Others tend to be used more at specific times of the year. The solar access controls may correlate with their greatest use OR they were already in the shadow of buildings when the rules were first developed and it wasn't viable to protect sunlight admission.
- Solar controls in mid-winter can place significant constraints on development potential particularly on sites to the north. This factor is worth considering when developing solar amenity controls. The Albert Park controls have defined much of Auckland's built form; many building roofs are shaped by the height planes. Regardless, the city considers these controls very successful in spite of significant development pressure and have no plans to amend them.

Burwood Council

Burwood Park

Policy	Burwood DCP 2013
Objective	To ensure that there is adequate solar access to Burwood Park
Control	Development must not cast shadows over Burwood Park between 10.00am and 2.00pm (4 hours) on 21 June
Pros	• Ensures more than 4 hours of sunlight all year on nearly 100% of the total area of the park • Sunlight access allows for good tree & plant growth and less frequent replacement of turf.
Cons	• May limit urban intensification surrounding the park because the control applies to the whole park • Potential for the control to be weakened through review of controls due to the projected uplift of the Parramatta Road Urban Design Strategy.
Conclusion	● Best Practice ○ Adequate ○ Poor

What does Burwood Council have to say?

Summary of interview with Group Manager of Strategic Planning at Burwood Council

- Burwood has been named as a strategic centre as part of the Parramatta Road Urban Design Strategy. Council is currently reviewing the potential impacts & appropriateness of uplift in city centre alongside Strathfield Council and City of Canada Bay Council.
- The review shows that there is potential for devastating impacts of overshadowing to the public spaces in the city centre including Burwood Park.
- Burwood Council is currently reviewing its Local Strategic Planning Statement and is hoping to protect and expand its solar amenity policy across key public spaces.
- Council wishes to maintain at least 4 hours of uninterrupted sunlight in winter on its public open spaces.

Willoughby City Council

Chatswood Oval & CBD Public Spaces

Policy	'Chatswood CBD Planning and Urban Design Strategy to 2036' Adopted 2018
Objective	Ensuring adequate solar access depending on the type of open space during lunch hours
Control	Active Spaces: No additional overshadowing 11am - 2pm (3 hours) 21 June to Oval Passive Spaces: No additional overshadowing 12pm - 2pm (2 hours) 21 June to Other spaces Controlled by a height plane map
Pros	• Limits overshadowing to active spaces without limiting the balanced development potential
Cons	• Currently the oval does not get 4 hours of uninterrupted sunlight in winter. The 3hrs control was not based on best practice. The control is retroactive as development near the park was previously allowed, which created overshadowing impact. The 3hrs controls derived from the current sunlight condition of the park • Control derived from scenarios for development potential rather than the best outcome for the park, nature and people • 2 hours of sunlight in midwinter for passive open spaces is not enough to ensure good solar amenity for people and is not adequate to ensure enough sun for turf, flowers and proper tree growth
Conclusion	Active Spaces: ○ Best Practice ● Adequate ○ Poor Passive Spaces: ○ Best Practice ○ Adequate ● Poor

What does Willoughby Council have to say?

Summary of interview with Strategic Planner at Willoughby City Council

- In 2016, Architectus was engaged to prepare the Chatswood CBD Planning and Urban Design Strategy, which establishes the framework to guide all future private and public development in the Centre over the next 20 years. The strategy contains three scenarios for development: [1] no changes to current building height and FSR controls; [2] high-growth model; and [3] balanced-growth model. The testing of sun access on public parks in the CBD was done for each scenario. The Balanced option was adopted by Council and released as a strategy
- Architectus' Planning and Urban Design Strategy makes recommendations for sun access controls. The aim of sun access controls is to ensure [1] three hours of sunlight in midwinter on high-use/active open spaces during lunch time; and [2] two hours of sunlight in midwinter on lower-use/passive open spaces during lunch time. The oval is a high-use active space which has local and regional importance
- The sun access control is enforced through building height plane controls

North Sydney Council

Any Space Zoned RE1 Or Identified As Special Area*

Policy	North Sydney LEP 2013 - Clause 3.3.2, 4.6, DCP 2013 - 2.3.7 Solar Access
Objective	Preserving and creating solar amenity in the city centre for thermal comfort
Control	No Additional Overshadowing, 12pm-2pm (2 hours) between March – Sept Equinoxes
Pros	• Clear metric
Cons	• Driven by development rather than providing amenity for people & nature. The solar amenity control in NLEP 2013 has been reviewed as part of the North Sydney Centre Capacity and Land Use Strategy. It was concluded that special provisions beyond the NLEP 2013 overshadowing controls and the Apartment Design Guide were considered an unreasonable constraint to development within a growing central business district. • Not enough sunlight (only 2 hours) on public spaces will impact flora and fauna, as well as people's wellbeing and behaviour. • A retroactive control as urban intensification was permitted in the past, creating overshadowing impact on the parks
Conclusion	Best Practice ○ Adequate ○ Poor ●

What does North Sydney Council have to say?

Summary of interview with Executive Strategic Planner at North Sydney Council

- Overshadowing controls under NSLEP 2013 relate to developments located within the North Sydney Centre only. They have been in force since 2003.
- The majority of the open spaces in the Centre are in private ownership. Due to the density of developments within the Centre, it is important that any existing amenity is not further eroded. This is why the overshadowing controls cannot be varied under Clause 4.6 of Council's LEP.
- Consideration may be made in the future to expand this style of control to other areas such as St Leonards and Crows Nest.
- The overshadowing control applies on winter solstice through to the equinoxes when solar access is most sought after for thermal comfort.
- The majority of the parks/plazas in the Centre contain high levels of impermeable surfaces, so maintenance of turf & planting is not an issue.
- The new public domain strategy seeks to create new publicly accessible open space. The solar amenity to these new spaces will be addressed as part of any new planning proposal.

Overview of Research

This Best Practice Research reviewed twenty one solar amenity controls across twelve councils nationally and internationally, including Auckland City Council, Brisbane City Council, Burwood Council, City of Gold Coast, City of Parramatta, City of Sydney, City of Copenhagen, City of London, New York City Council, Melbourne City Council, North Sydney Council and Willoughby Council.

Planning policies for cities such as London, New York and Copenhagen were investigated, however it became apparent that due to the different climates, latitudes and planning systems in these cities, they were not comparable to CBCity and the NSW Planning System.

Key research findings from local councils in Australia and New Zealand are summarized below.

- **Six out of seventeen controls (35%) require a minimum of 4 to 5 hours continuous sunlight to at least 50 percent of the area of the park on the winter solstice**. These controls have been adopted for all city centre parks and open spaces by Melbourne City Council, all parks and open spaces in urban renewal areas by Melbourne City Council, Burwood Park by Burwood Council, Albert Park by Auckland City Council, Green Square by City of Sydney except Green Square Town Centre and Harold Park by City of Sydney. These open spaces are similar in purpose or size to a central CBD city park, such as Paul Keating Park. The strategic planning departments of these councils stated that their research shows the control provides adequate solar amenity for key parks in city centres or urban renewal areas. These controls are evaluated as 'best practice' in the context of CBCity's CBDs and urban renewal areas and are recommended for adoption.

  Best Practice Adequate Poor

- **Two out of seventeen controls (12%) require a minimum of 3 to 3.5 hours continuous sunlight to at least 50 percent of the area of the park on the winter solstice**. These controls have been adopted for Myers Parks by Auckland City Council and Chatswood Oval by Willoughby Council. **The controls are retroactive and derived from the current sunlight condition of the parks** as high-density developments near the parks were previously allowed, which created overshadowing impact on the parks, and limited the ability to protect sunlight for more than 3 to 3.5hrs. These controls are evaluated as 'adequate' in the context of CBCity's CBDs and urban renewal areas. However, are not relevant to main parks in CBCity's main centres that receive more than 4 hours of sunlight in winter.

  Best Practice Adequate Poor

- **Seven out of seventeen controls (40%) require a minimum of 2 hours continuous sunlight to at least 50 percent of the area of the park on the winter solstice**. These controls have been adopted for city squares by Brisbane Council, a pedestrian street (Emily Place) by Auckland City Council, open spaces zoned RE 1 or identified as Special Areas by North Sydney Council, small pocket parks or plazas in the city centre by Willoughby City Council and Jubilee Park, Lancer Barracks and Parramatta Square by Parramatta Council. **It is important to note that the majority of these open spaces are either privately owned (the case of North Sydney), or are small public plazas or pedestrian streets, except Jubilee Park. These open spaces are not comparable to a main CBD city park, such as Paul Keating Park** and the controls do not provide an acceptable level of sunlight protection for main parks in winter. These control are evaluated as poor in the context of CBCity's CBDs and urban renewal areas and are not recommended for adoption.

- **Only one out of seventeen controls (0.5%) allows for moving shadow each hour for three hours on the winter solstice** (Drying Green by City of Sydney), while the other sixteen controls require continuous sunlight to reach the park on the winter solstice. **The City of Sydney urban design team is not satisfied with this control and has not adopted the same control anywhere else.** The 'moving shadow control' has been justified as adequate by some individuals in the development and consulting industries on the basis that people can move around, chasing the sun in the park. This argument, however, disregards the fact that [1] moving shadow does not provide enough sun in winter for nature to thrive; [2] fixed public furniture that is in shade is not well-used by people in winter; [3] people having picnics and larger groups are less likely to move to follow the sun as it is a nuisance having to move around frequently to enjoy the sun in a public space; and [4] moving shadow further limits the area of the park that receives adequate sunlight in winter, thus limiting the number of people that can enjoy a spot in the sun in winter. The control is evaluated as poor in the context of CBCity's CBDs and urban renewal areas and is not recommended for adoption.

- **Only one out of seventeen controls (0.5%) protects solar amenity on the Equinox and summer months** (Aoeta Square by Auckland City Council). The other sixteen controls protect solar amenity on the winter solstice or all year round. **Aoeta Square is not comparable to a central CBD city park, such as Paul Keating Park**, **and does not provide adequate solar amenity for parks in winter**. The control is evaluated as poor in the context of CBCity's CBDs and urban renewal areas and is not recommended for adoption.

  Best Practice Adequate Poor

Nature, Health & People's Wellbeing

The Effects of Sunlight on Nature & Eco-Systems

Evidence and expert knowledge demonstrate a link between the amount of sunlight and the durability and development of turf surfaces, flowering plants and tree growth. CBCity's experts in landscape architecture and arboriculture, City of Sydney Urban Design Coordinator and several articles prepared by experts in the field confirm the following facts:

1. Turf requires 5 to 6 hours of daily sunlight throughout the year to thrive[1]

- 4 hours of daily sunlight throughout the year is the absolute minimum required for turf surfaces to thrive
- Grasses in low-light areas that receive less that 4 hours of daily sunlight are more sensitive to maintenance. Replacement of turf surfaces become more frequent - less than 1 year depending on the usability of the park - and access is restricted during the 6-8 week establishment period of replaces turf surfaces. Turf surfaces require special care to minimise damage from mowing
- The most shade tolerant grasses still require at least 4 hours of sunlight to survive

2. Without a minimum of 4 hours of daily sunlight throughout the year, plant diversity is limited[2]

- Flowering plants do not grow in low-sun conditions. Many native flowering plants in Eastern Australia require at least 4 hours of sunlight in winter
- Plant diversity is limited in areas receiving less than 4 hours of daily sunlight throughout the year, inhibiting the survival of many full-sun and partial-sun plants
- On areas receiving less than 3 hours of daily sunlight, only full-shaded plants can be planted, which then cannot tolerate the full sun of the summer months
- The absolute minimum sunlight required for most shade-tolerant plants is 3 hours of indirect sunlight
- Seasonal flowering of already established flowering plants and trees in parks can be adversely impacted by overshadowing of new high-density developments, thus limiting the source of nectar for nectar-eating fauna

3. Trees naturally grow towards light,which is called phototropism

- With a lack of sunlight, trees grow tall rather than wide meaning they are spindly and sparse. This provides limited canopy cover, foliage and flowers. This rapid growth rate weakens the trunk of the tree and increases the distance between nodes and branches making them vulnerable to structural weakness and damage during windy weather events[3]
- An additional effect of phototropism in areas with a lack of sunlight is asymmetrical, irregular tree growth. This effect is less than desirable in main urban parks in the CBCity centres

4. Without proper sunlight, moss grows on natural paving materials creating slippery surfaces.[4]

- Shaded areas are conducive to moss growth on hard landscaped surfaces as a result of lack of vegetation or damp soils due to poor drainage or regular water runoff. Excessive moss growth on hard landscaping is a potential slip hazard and will require increased maintenance to mitigate the hazards
- Impact of reduced access to sunlight during the winter months will result in the replacement of turf areas with increased paved spaces and reduced quality and quantity of the tree canopy. This not only creates colder, harder, wetter landscapes in winter it also produces hotter, dryer, more exposed spaces in summer with an escalation in the urban heat effect, making these spaces unusable for many months of the year.

1 https://www.bioadvanced.com/articles/lawn-care-how-grow-grass-shade
2 http://www.mountainnursery.com.au/australian-native-flowers
3 https://homeguides.sfgate.com/plants-dont-enough-light-grow-tall-spindly-71340.html

4 https://www.greenwaybiotech.com/blogs/news/the-real-reason-why-moss-keeps-growing-in-your-garden-and-what-you-can-do-about-it

The Effects of Sunlight & Nature on People's Wellbeing

Research findings indicate that exposure to natural environments improves people's wellbeing. Without adequate sunlight, natural environments cannot thrive.

1. Exposure to Natural Environments improves Physical, Mental and Social Wellbeing.[1]

- Research shows that city dwellers have a 20% higher chance of suffering anxiety and an almost 40% greater likelihood of developing depression then city dwellers that are exposed to natural environments.
- Exposure to nature can reduce symptoms of stress, mental fatigue and increase concentration. Daily doses of urban nature deliver benefits of improved physical, mental and social wellbeing.
- Research indicates that providing walkable spaces, community space and greenspace are all part of ensuring the urban environment gives benefits to people.

2. Biodiversity and functioning ecosystems are vital to achieving the benefits of green spaces.[2]

- "Biodiversity has been linked with human wellbeing.. Biodiversity is also integral to the healthy functioning of an ecosystem. Human wellbeing is contingent on ecosystem functioning – the air we breathe, the food we eat, the water we drink – all require functioning ecological integrity" "... biodiversity and ecosystem function is critical to human health and wellbeing."

3. Children have been found to be more creative during playtime after exposure to nature.[3]

- "..there was significantly more play and more creative play in high-vegetation spaces."
- "all children could benefit from nearby outdoor spaces that are attractive and supportive of developmentally important behaviours."
- children in inner neighbourhoods exposed to leafy green spaces demonstrated higher attention levels and greater self-discipline

4. Different types of green spaces have differing effects on wellbeing.[4]

- "..research has also found that people in urban areas who live closest to the greatest amount of 'green spaces' are significantly less likely to suffer poor mental health."
- "Many urban parks and green spaces – particularly in residential areas – are unimaginative, repetitive and lack basic elements to evoke these references to nature. Nor do they encourage walking or enjoying the natural elements for any length of time."
- "Successful parks and urban green spaces encourage us to linger, to rest, to walk for longer. That, in turn, provides the time to maximise restorative mental benefits."

5. Even just viewing green space through a window for 40 seconds can have an uplifting impact to wellbeing.[5]

- "A micro-break viewing a green, but not concrete roof city scene, sustains attention.. .. Participants (of the study) who briefly viewed the green roof made significantly lower omission errors, and showed more consistency responding to the task compared to participants who viewed the concrete roof."

6. Contact with nature mitigates mental fatigue and may reduce anxiety and aggression.[6]

- "there is an increasing recognition that deprivation of human populations from natural environments can have detrimental psychological, perhaps even physiological, effects, depressing the spirits and leading to increasingly manic, criminally dishonest and violent behaviour."[7]

Research findings indicate that exposure to sunlight improves people's wellbeing.

1. The health benefits of sunlight exposure extends beyond curing Vitamin D deficiency.[8]

- Exposure to sunlight assists the body's cellular defense mechanisms, lowering inflammation and risk of autoimmune diseases such as Lupus, MS and Type 1 diabetes
- Minimal levels of UVA assists in regulating circadian rhythms
- UVA has also been shown to lower blood pressure, increase blood flow and heart rate, all of which are beneficial to the heart and blood vessels.
- "a moderate degree of UV exposure is necessary for the production of Vitamin D which is essential for bone health. Additionally, evidence emerges that low Vitamin D levels are likely to be associated with other chronic diseases. Thus, public health policy on ultraviolet radiation needs to aim at preventing the disease burden associated both with excessive and with insufficient UV exposure." [9]

2. Sunlight also has mental health benefits as exposure increases serotonin levels. Lack of sunlight exposure is associated with depression such as Seasonal Affective Disorder.[10] [11]

1 https://theconversation.com/why-daily-doses-of-nature-in-the-city-matter-for-people-and-the-planet-106918
2 Taylor, L. & Hochuli, D.F. Urban Ecosystem (2015) 18: 747. https://doi.org/10.1007/s11252-014-0427-3
3 Growing Up in the Inner City: Green Spaces as Places to Grow. Environment and Behavior, Vol. 30 No. 1, January 1996 p3 - 27
4 https://theconversation.com/green-for-wellbeing-science-tells-us-how-to-design-urban-spaces-that-heal-us-82437
5 https://www.sciencedirect.com/science/article/abs/pii/S0272494415000328
6 Aggression and violence in the inner city: Effects of Environment via Mental Fatigue. Environment and Behavior, Vol. 33 No. 4, July 2001 p543-571
7 Social housing and green space: a case study in Inner London. Elizabeth O'Brien. Forestry, Vol. 79, No. 5, 2006
8 https://theconversation.com/secret-to-health-benefits-of-sunshine-is-more-than-vitamin-d-34543
9 Solar ultraviolet radiation : global burden of disease from solar ultraviolet radiation / Robyn Lucas ... [et al.] ; editors, Annette Prüss-Üstün ... [et al.].
(WHO Environmental burden of disease series ; no. 13.)
10 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2290997/
11 Benefits of Sunlight: A Bright Spot for Human Health, M. Nathaniel Mead. Environmental Health Perspective. 2008 Apr; 116(4): A160–A167

Conclusions

Conclusions

The research on solar amenity controls has highlighted that sunlight control is best measured on the winter solstice, as benchmarking solar access on the darkest day of the year ensures sun exposure all year round. Best practice policies have a clear objective, an easy to follow metric and allow for 4 to 5 hours of uninterrupted sunlight on the winter solstice to either a minimum of 50 percent of the total park area or for 100% of the active zones of the park (containing turf surfaces and soft landscaping). These controls allow sensible development to occur on lots near parks while maintaining adequate standards of amenity to the parks, thus achieving a balanced approach between public benefit, amenity, development and urban densification.

The controls evaluated as adequate in this research were put in place to prohibit any additional overshadowing on parks on the winter solstice. These are regarded as retroactive controls because higher density developments near the parks were permitted before solar amenity controls were put in place, creating overshadowing impact on the parks. They are considered adequate as it maintains existing sunlight conditions, but are not necessarily best practice or based on evidence as many of the parks receive only 3 hours of sunlight on the winter solstice. Controls that prohibit any additional overshadowing on parks are not deemed appropriate for many parks in CBCity centres not yet subject to urban renewal and densification. This is because many parks receive sunlight in winter in excess of 6 hours for 80% to 100% of the total park area. Therefore, maintaining current sunlight conditions to some of these parks would inhibit the development potential of surrounding lots on key strategic centres, thus hindering economic prosperity of our centres.

The controls evaluated as ‘poor’ require less than 4 hours of uninterrupted sunlight (generally 2 hours only) on the winter solstice, or 1 hour of uninterrupted sunlight for a period of 4 hours on the winter solstice, or they protect sunlight on equinoxes or summer solstice only. They are deemed poor for the CBCity context as it would significantly impact adversely on the City’s natural environment and people’s wellbeing and behaviour in parks. Many of these controls were developed to allow urban densification, but adversely impacted the amenity of the public domain.

The research on sunlight and nature has revealed several key insights into solar amenity to open spaces in city centres. The research on the effects of sunlight on nature and ecosystems shows that maximising uninterrupted sun exposure in winter is critical as turf requires at least 5 hours of sunlight to thrive, while flowering plants and trees need at least 4 hours to grow properly. The effects of not enough sun include constant replacement of turf, undesirable phototropism of trees and plants, moss and lichen growth and a lack of plant diversity. These facts have been corroborated by Council’s experts in landscape architecture and arboriculture, City of Sydney Urban Design Coordinator and several articles prepared by experts in the field.

The research on the effects of nature and sunlight on people’s wellbeing indicate that exposure to natural environments improves people’s physical, mental and social wellbeing. Children are more creative after exposure to nature. Contact with nature mitigates individuals’ anxiety, mental fatigue and aggression and improves concentration. Additionally, moderate exposure to sunlight improves people’s mental and physical health. Lack of sunlight in public spaces can affect sight-impaired individuals, reduces opportunities for outdoor socialisation, and open spaces become barren and dull.

Recommendations

Recommendations

It is recommended that the following steps be undertaken:

1. Adopt a solar amenity policy for Paul Keating Park and Bankstown Court House Reserve as follows

Objectives

- To achieve a comfortable and enjoyable public realm.
- To ensure new buildings and works allow sunlight access to public spaces as specified in the provisions.
- To ensure that overshadowing from new buildings or works does not result in adverse impact on the existing and future use, quality and amenity of the public spaces.
- To protect, and where possible increase the level of sunlight to the public spaces during the times of the year as specified in the provisions.
- To protect the natural landscaping, including trees, plants and lawn or turf surfaces in the public spaces.
- To protect the cultural or social significance of the public spaces.

Provisions

- Development must allow for 4 hours of continuous solar access to minimum 50 percent of the area of Paul Keating Park between 10.00 am and 3.00 pm on 21 June (inclusive of existing shadow). The area of Paul Keating Park is defined as the property at 375 Chapel Road (DP777510 parcel nº6), exclusive of the footprint of the Council Chambers Building.
- Development must not cast additional shadow on the Bankstown Court House Reserve between 10.00 am and 2.00 pm on 21 June for at least 50 percent of the total park area.

Policy Implementation

In considering the impact of additional overshadowing, the responsible authority will assess whether the additional overshadowing adversely affects the use, quality and amenity of the public space. The following matters will be considered as appropriate:

- The area of additional overshadowing relative to the area of remaining sunlit space compared to the total area of the public space;
- Any adverse impact on the cultural or social significance of the public space;
- Any adverse impact on the natural landscaping, including trees, plants and lawn or turf surfaces in the public space;
- Whether the additional overshadowing compromises the existing and future use, quality and amenity of the public space.

Shadow diagrams must be submitted with the development application and indicate the existing condition and proposed shadows between the hours of 9am and 3pm on 21 June at 10-minute intervals. The analysis must clearly illustrate existing overshadowing cast by existing buildings on and around the public spaces. If required, the consent authority may request additional detail to assess the overshadowing impacts.

2. Develop an evidence-based sun protection control framework for open spaces to guide the sustainable growth of CBCity's centres, including a modelling analysis of sunlight access to public parks similar to the report developed by Hoddle & Co for City of Melbourne.

Three options for solar amenity controls should be considered and the interim should be used as a guide for development assessment:

Option One: Influenced by the City of Melbourne

Park types that ensure no additional overshadowing between 10am-3pm to maximise winter solstice sun access, providing at least 5 hours of solar amenity in most parks. A flat control across most parks would future proof the solar amenity of parks within the municipality from development. City of Melbourne control allows for planned urban renewal precincts with similar densities to that of CBCity and acknowledges parks that do not currently achieve the 5 hours of similar amenity. Such control should be subject to modelling analysis and consideration of clear and detailed objectives.

Option Two: Influenced by the City of Sydney's South Sydney DCP 1997

50 percent of the total area of the park to receive uninterrupted sunlight between 10am and 2pm (4 hours) on the winter solstice (21 June). The wording must ensure sufficient solar access to the active/landscaped/turfed areas of a park. Clear and detailed objectives to also be developed.

Option Three: Influenced by Auckland City Council's controls for Albert Park

This can only be used on specific cases where park infrastructure, soft and hard landscaping and tree canopy will not undergo significant changes in the near future. The control divides up the park into a number of zones in accordance with the level and type of soft and hard landscaping, tree coverage, uses, park infrastructure, etc. These controls allow for sun access all year round for the most active/landscaped/turfed areas of the park, providing a minimum of 4 hours of uninterrupted sunlight on the winter solstice to 100% of the area. Forested areas with existing mature trees already overshadowing the ground would require less sun access control, while areas of turf are more diverse in their use and plant species and have a greater requirement of sunlight. This control could enable specific areas of the park to achieve 4 to 5 hours of uninterrupted sunlight in winter, but acknowledges that not every space may need the same level of solar amenity or may not currently achieve this benchmark. Clear and detailed objectives to also be developed.

In the interim, these three options should be used as a guide for development assessment.

Recommendations

Other factors that affect the solar access controls and the priority and importance of the solar access controls to be considered are:

- Size and type of open space (regional parks, playing fields, local parks, active/ passive areas, playgrounds, urban plazas, nature corridors, linear parks, pocket parks etc)
- Site context
- Availability of open space in the area (or lack of)

For example, Paul Keating Park is a key active open space for the Bankstown CBD. It serves and will continue to serve a large and growing population of residents, visitors, workers and students. The area surrounding the park has been identified as having an undersupply of open spaces. This elevates the importance of amenity and solar access for Paul Keating Park, whereas a lower order park or plaza with a lower population catchment may require different levels of amenity and solar access.

3. Expand evidence-based research on solar amenity controls to pedestrian streets, other important streets, urban plazas, etc. to ensure adequate sun protection on other key open spaces in the City centres.