The regional vision for SEQ is for a future that is sustainable, affordable, prosperous, liveable and resilient to climate change, where:

"...communities are safe, healthy, accessible and inclusive; there are diverse employment opportunities, and quality infrastructure and services, including education and health; urban and rural areas are mutually supportive and collaborative in creating wealth for the community; development is sustainable, well-designed and the subtropical character of the region is recognised and reinforced; ecological and culturally significant landscapes are valued, celebrated and protected; and the community has access to a range of quality open space and recreational opportunities."

South East Queensland Regional Plan 2009–2031
FOREWORD

We take great pleasure in commending this publication to all those who have an interest in ensuring that the growth and prosperity of South East Queensland goes hand in hand with intelligent, thoughtful planning and good design. This will help to retain the unique quality and characteristics of the region, while enhancing natural attractions and embracing our subtropical climate.

Covering an area of 22,890 square kilometres, the South East Queensland region stretches 240 kilometres from Noosa in the north to its southern border in Coolangatta, and extends 160 kilometres west to Toowoomba. The landscape is a rich mix of city, bushland, beaches, ranges, rivers and lakes with a heavily urbanised population concentrated along the coast.

Responsibility for this thriving region of the State is shared among 11 city and regional councils. Central to this shared management is the South East Queensland Regional Plan 2009 - 2031, which identifies the best way forward to accommodate the region’s rapid growth including requiring more homes and support infrastructure. The South East Queensland Regional Plan seeks to protect more than 80 per cent of the region from urban encroachment by containing development within an Urban Footprint delineated for future urban growth.

An essential component of the South East Queensland Regional Plan is the inclusion of 12 principles for subtropical design which emphasise accessible open space systems, pedestrian connectivity and active public spaces. This handbook, "Subtropical Design in South East Queensland", is intended as a practical guide to assist planners, developers and decision makers understand and adapt the concept of subtropical design to their work. Its many practical examples, photographs and illustrations demonstrate appropriate design in a subtropical setting, the implementation of which will assist in reducing our energy usage and carbon emissions.

We encourage you as professionals to plan, design and develop South East Queensland as a world-renowned, sustainable, subtropical place.

The Honourable Stirling Hinchliffe MP
Minister for Infrastructure and Planning

The Right Honourable, the Lord Mayor of Brisbane
Councillor Campbell Newman

Professor Peter Coaldrake
Vice-Chancellor Queensland University of Technology
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PART ONE
Setting the Scene
**Preamble**

South East Queensland is Australia’s fastest-growing region, attracting an average of 55,000 new residents each year. The historic South East Queensland Regional Plan 2005-2026 (OUUM, 2005), and subsequent South East Queensland Regional Plan 2009-2031 (DIP, 2009) aim to manage growth sustainably through a policy of compact urbanisation and consolidation.

This requires the community to embrace a transition to a level of density not previously experienced in the generally low-density environment of Queensland. A critical characteristic of the regional vision is that ‘development is sustainable, well-designed, and the subtropical character of the region is recognised and reinforced’.

The explicit inclusion of the subtropical aspect with sustainability in the regional planning agenda recognises the significant roles that regional identity and appropriate design for climate play in development that is both liveable and ecologically sustainable.

Public policy now recognises that the region’s climate can be used to advantage to develop low-energy urban form, and low-energy buildings. Urban sustainability and consolidation of the urban environment in South East Queensland require deliberate attention to “place based” planning and urban design.

Urban development which responds to ‘place’ by being designed with appreciation of climate, landscape and local lifestyle contributes to a healthy environment, a viable economy and a vibrant society. Conversely, poor planning can result in urban landscapes which exacerbate the negative impacts of urbanisation on natural resources and cause a loss of local distinctiveness.

In decisions about what, where, how, and why to build, in South East Queensland strategic planning that is guided by subtropical design principles at the earliest stages of the process, is more likely to deliver long-term goals in the urban environment.

By understanding the immediate and long-term benefits of subtropical urban design, it will be easy to argue the case for its implementation in individual developments as well as in plans for neighbourhoods, cities and local government areas.

Subtropical design and sustainable urban design are mutually reinforcing. No urban elements, spaces or places can be considered sustainable if their designs do not respond to nature, climate, local character and lifestyle.

**Population demands**

The population of the South East Queensland (SEQ) region is expected to increase to 4.4 million in 2031 (DIP, 2009). In 2006, existing dwellings in the region numbered 1,124,390. The projected population increase, combined with the continuing trend towards smaller households will require an estimated 754,000 new dwellings to be constructed by 2031. Almost half these new dwellings are expected to be created in infill and redevelopment areas, and the balance on broadhectare land. The large number of new homes, and the accompanying infrastructure they require, will have a major impact on the region and the urban form of its cities as they undergo a shift to higher levels of urban density than previously experienced. The Queensland Government, working with regional and city councils, has established an overall regional plan with statutory authority to meet this urban planning challenge, and to take into account the need to adapt planning models to suit climate conditions.

**Subtropical design principles in the SEQ Regional Plan**

The South East Queensland Regional Plan (the Plan) presents a set of regional policies to guide state and local area planning, and urban development within a sustainability framework. One of the key policies, compact settlement, aspires to ‘a compact urban structure of well-planned communities, supported by a network of accessible and convenient centres and transit corridors linking residential areas to employment locations...’ to ‘reflect SEQ’s subtropical climate, reinforce local character and achieve innovation and design excellence’. To support this policy, the Plan sets out 12 guiding principles of subtropical design.
• Recognise sub-regions: recognise and reflect the diversity of climatic, landscape, cultural, and habitat sub-regions of SEQ in the application of design principles.
• Respect topography: protect the integrity and character of the hills, mountains and ridgelines that are important in framing and defining the subtropical environment.
• Diversify the built environment: incorporate a diversity of building densities, heights, type, and scale into new developments.
• Consider local character and design: recognise the contribution of contemporary design and appropriate use of building materials to the character and diversity of the subtropical environment.
• Integrate with nature: design for appropriate climate-based orientation, provide shade and allow for the penetration of breeze, sunlight and the natural environment.
• Acknowledge informality: recognise the informal relationship between the natural, built and rural environments.
• Use vegetation: make use of extensive native vegetation and large shade trees in private and public spaces.
• Ensure open space diversity: ensure open space is diverse, integrated and designed to form networks.
• Incorporate access to open space: reflect the proximity of nature in subtropical environments and SEQ’s outdoor-based lifestyle in the access to open space.
• Design for water: reflect the importance and presence of water and provide for public access to any natural or artificial waterways.
• Develop outdoor centres: outdoor dining, entertainment, recreation, sheltered access to public transport and shaded pedestrian pathways are the attributes of informality and village-like character.
• Develop outdoor meeting places: incorporate outdoor meeting places into building and design.

As these principles are presented in the SEQ Regional Plan as high level concepts, another level of information is needed in local planning schemes to progress from the broad non-operational principle to a local direction for subtropical design.

Purpose of this handbook
Currently there is no direct link between these 12 principles and day-to-day development assessment processes by local authorities.

The intention of this handbook is to provide advice to the planning community on how subtropical design principles apply within the different contexts of urban planning. Strategies that can be applied to the entire spectrum of urban scales from the regional scale, to the city, neighbourhood, street, individual building or site are suggested. These are drawn predominantly from the body of knowledge of landscape architecture, architecture and urban design.

The aim is also to enhance the sharing of information related to subtropical design amongst state and local planning agencies, as well as to provide planners and developers with the common basis for the preparation and assessment of planning applications.

Structure of the handbook
Part Two discusses the influences on the character and identity of SEQ, and the role that place-identity plays in achieving environmental sustainability. Values of local distinctiveness are identified and the environmental, social and economic benefits of applying subtropical design principles to planning, urban design and architecture are described.

Part Three presents each of the 12 principles as they appear in the SEQ Plan. An explanation of why each principle is important is followed by practical implementation strategies. Many strategies are applicable to more than one principle and these are cross-referenced in the handbook.

The strategies incorporate and enhance established climate-sensitive urban design approaches. They also reflect guidelines for water-sensitive urban design, and provide recommendations for sustainable subtropical neighbourhood design.

Some terms are italicised and explained further in Part Four where a glossary of terms and useful references are provided.
Notes on climate
So benign is the climate in subtropical South East Queensland (SEQ) that the natural conditions allow comfortable outdoor living all year round. The environmental temperature only slips outside the comfort zone on the coldest of winter mornings and on some sweltering summer days when heat and humidity combine. SEQ experiences neither searing nor freezing temperatures that other population centres in Australia and overseas routinely contend with. In theory, this means that in SEQ the need to artificially cool or heat habitable spaces is much less pressing than it is elsewhere.

SEQ’s climate is characterised by warm, humid, and often wet, summers with mild dry winters. North-east and south-east onshore breezes prevail during much of the year; and dry, high winds (notably cold westerlies) are common in winter. There is some climate variation from the coastal strip to the hinterland and inland areas because of the moderating effect of the Pacific Ocean on temperature fluctuations. Daytime onshore winds and the cooling effect of adjacent uplands result in a low frequency of heat discomfort in coastal areas. However, the further from the coast, the higher the summer temperatures and the colder the winter temperatures.

According to the Australian Bureau of Meteorology, the average number of heat discomfort days per year in the Brisbane area is between five and ten, with one day over 35°C, on average. Though the Office of Climate Change forecasts the number of days over 35°C will double by 2030, and weather events such as severe storms and flooding will occur more frequently and with greater severity, the climate experienced in SEQ is predicted to continue to be generally equable compared to many parts of Australia.

Notes on regional character and identity
SEQ’s distinctive character and identity has evolved in response to the subtropical climate and the diversity of natural landscapes. A synergy between the built environment and the subtropical setting developed in SEQ as it urbanised from the 19th century onwards. Suburbia pre-dating World War II is characterised by the high-set ‘timber and tin’ housing known as the Queensland vernacular. The lightweight frame and skin of the popular housing form readily accommodated the south-east’s hilly terrain. Space for outdoor living, and a backdrop of large flowering specimen trees and lush vegetation complemented buildings in the urban fabric.

Until the post-war era, many individual dwellings and patterns of settlement were well-reconciled to the surroundings and were imbued with the subtle central quality of being ‘at home’ with the environment.

In recent decades urban development lost this synergism with climate and place, with dwellings and neighbourhoods becoming very resource-intensive, and typically car-dominated. As SEQ experiences the pressures of population growth, and as more people turn to the air-conditioner to neutralise indoor climate, the region’s generally pleasant macro-climatic characteristics are ignored, regional character and identity is under threat, and consumption of energy has steadily increased. Buildings and neighbourhoods of indifferent design have proliferated, and growth and sprawl are perceived to have eroded the nature-based character of SEQ.

Subtropical urban values
One way to address the problems of contemporary urbanism is through reconnection to, and creative engagement with the climate, landscape and culture; that is, through a place’s character and identity. Brisbane City Council notably made the connection between planning, design and climate in the Living in Brisbane 2010 corporate vision, with aspirations for ‘a city designed for subtropical living’ amongst other themes. The SEQ Regional Plan 2005-2026 followed this lead in 2005 in its vision for the SEQ region as a whole. The re-worked Brisbane City Council vision, Living in Brisbane 2026, describes ‘a well-designed subtropical city – where you can hear the birds by day, and see the stars at night’, clearly linking city planning and design to a biodiverse, pollution-free, healthy environment. It is now well established that regional planning recognises that the region’s climate-derived character can be used to advantage to develop low-energy urban form and innovative low-energy buildings.

1 The Office of Climate Change in the Queensland Government has prepared a document ‘Climate Change in Queensland: What the science is telling us’. This analyses international and national climate change science and assesses its significance to Queensland’s regions and sectors. The report draws on two main sources: the IPCC Fourth Assessment Report and the CSIRO and Australian Bureau of Meteorology Climate Change in Australia – Technical Report 2007.
The place-identity perspective is an extremely valuable driver for achieving ecologically sustainable urbanism. However, discussions of character and identity in subtropical Queensland are often heavily influenced by the low-density ethos, and are sometimes misinterpreted as an imperative to preserve what is distinctive about individual vernacular houses, rather than as an impetus to prevent the degeneration of the local environment and support future urban lifestyles to be less reliant on fossil fuel energy.

Community concerns about urban consolidation and higher levels of urban density are related to perceptions of diminishment of open spaces which traditionally have been available for outdoor activities and enjoyment of an informal subtropical lifestyle. Underscoring these concerns are many contemporary examples of buildings and suburbs which ignore the values of subtropical place-responsiveness.

Historically, open spaces in low-density detached residential development in SEQ were almost incidental, yet were used for a variety of outdoor living activities as they often provided greater levels of thermal comfort than the interiors of dwellings. As urban development becomes denser, open spaces where meaningful vegetation can thrive need to be consciously incorporated into dwellings and neighbourhoods. This will help fulfil the community’s desire for access to a diversity of outdoor living opportunities.

Meanwhile, the dual mainstream values of car dependency and increasing reliance on air-conditioned interiors, make it difficult to envisage how an alternative urbanism, which is less resource intensive yet more convivial and humane, can be achieved. Reducing reliance on fossil fuels and decreasing greenhouse gas emissions depends on communities and individuals having better choices regarding energy conservation. Energy demand reduction is an additional and immediate benefit of the application of subtropical design principles to the design of individual buildings, neighbourhoods and cities.

Through a series of design workshops and think tanks, the Centre for Subtropical Design has identified two overarching values which characterise subtropical place-identity in subtropical SEQ:

- A sense of openness, and permeability; and
- Engagement with natural environment.

These values are the essential ingredients of more compact, more sustainable subtropical urban environments. In expanded form they offer sustainability values based on local distinctiveness, and are critical success factors for subtropical urbanism:

- Openness and permeability in the urban setting allows for engagement with the natural environment through sensory awareness, openness to the sky, easy flow of breezes and access to open spaces.
- An open and permeable urban environment has a continuum of open space ranging from public places to private spaces. Compact urbanisation requires a higher emphasis on well-located semi-outdoor space than was the case in earlier low-density suburbia, where open space was largely unstructured garden space.
- Open and permeable buildings. The subtropical climate encourages structures which can be adjusted to suit weather or social conditions. The verandah, which mediates between indoors and outdoors, is a traditional manifestation of this approach.
- Life outdoors. With adequate shade, outdoor conditions are climatically agreeable all year round. Shaded public spaces, streets and pathways combined with urban design that favours pedestrians rather than vehicles, promote walkability and the connected compact city.
- Life outdoors. The subtropical climate has fostered a strong sense of informality in the subtropical lifestyle. Multi-purpose private, semi-private and public spaces conducive to outdoor living are essential in denser environments.
- Connection with natural environment and landscape. Significant natural features such as mountain ridgelines, rivers, headlands and beaches are valued and accessible both visually and physically.
- Strong presence of nature. The natural environment (land, air, flora and fauna) of subtropical SEQ is valued for environmental health, well-being and sustainability. Being aware of seasonal variations in light, air movement and direction, temperature, sounds and smells of
the city, are important for engagement with the natural advantages of the SEQ environment. As an example, substantial trees and vegetation temper the micro-climate and support animal and plant life in urban areas. Meaningful vegetation also absorbs carbon emissions, has an important role in the urban water cycle and provides rest for the eyes when all else is man-made.

- Strong presence of water. Traditionally, eaves guttering and pitched roofs are tangible reminders of respect for water in the built environment. All urban development must acknowledge that this cooling, refreshing, life-giving element is both finite and essential for a ‘living’ green city.

The challenge for developing contemporary design principles for appropriate outcomes for subtropical SEQ is the need to be explicit about how the changing urban environment can continue to express an ongoing positive relationship with the natural environment. To take the subtropical design approach is to understand the link between lifestyle and climate and how design that encourages living with our climate, rather than locking ourselves away from it, can achieve sustainable solutions. Subtropical design is climate responsive, resource conscious, water frugal, and values sensitive.

Applying subtropical design thinking to local planning

The application of subtropical design thinking has the potential to have significant positive impacts on the quality of the urban environment by:

- supporting positive interactions between human activities and the natural environment; and
- significantly reducing greenhouse gas emissions.

Not only are new solutions to the urban form and structure of our built environment and infrastructure (residences, workplaces, learning places, recreational spaces, neighbourhoods, roads, transport systems, pedestrian systems, open space networks) required, but also a change in community perceptions of how subtropical lifestyle values might be fulfilled.

Well-designed compact developments offer a healthy balance between built-up and open areas. Strategies to ensure that the denser urban environment will achieve a sense of openness and retain a strong presence of nature are applicable at all scales from the macro scale of the region, cities and neighbourhoods to the micro scale of streets and individual buildings.

Local planning documents can reflect subtropical design principles by identifying the values of ‘openness’ and ‘connection with nature’ as mechanisms to ensure the continuation of subtropical character as the urban environment becomes more consolidated. These values guide policies from land use to aesthetics and can be accentuated in planning policies.

Subtropical urban development at all scales:

- promotes local character and identity
- contributes to the creation of an open and permeable built environment
- connects indoors and outdoors in an integrated design
- conserves energy and limits greenhouse gas production
- conserves water and limits use of potable water
- supports biodiversity
- reduces waste and pollution of all kinds.
PART THREE
Subtropical Design Principles
While South East Queensland is generally classified as subtropical, the expression of its regional character is seen in the diversity of its sub-regional variations.

Subtropical main streets demonstrate fine-grain scale, and shade and shelter that make lingering in public open space very attractive and are a model for contemporary urban villages.
While South East Queensland (SEQ) is generally classified as subtropical, the expression of its regional character is seen in the diversity of its sub-regional variations, each of which presents a unique combination of natural and urban elements. This diversity offers specific local opportunities and challenges for appropriate design.

The landscape diversity of SEQ is represented by the coastal sand masses, volcanic hills and ranges, and river valleys which all support a wide range of vegetation types and important natural habitats. The region contains World Heritage listed areas such as Lamington National Park, and the Gondwana Rainforests.

In SEQ there are a number of recognised areas of outstanding natural beauty and attraction, for example, the Gold Coast hinterland, Moreton Bay islands, Glass House Mountains, Currumbin Valley, Tamborine Mountain, Beechmont, Blackall Range, Lockyer Valley, the Scenic Rim and Loganholme Wetlands.

These examples demonstrate that localities in the region are not homogeneous in terms of climate, ecology or even lifestyle. In terms of the built environment, different responses to localised climatic factors can be discerned in the historic centres of the cities of Brisbane, Ipswich and Toowoomba. The distinctive characteristics of sub-regions in SEQ are important to differentiate, and should be reflected in urban design applications and planning strategies, and in buildings and infrastructure, to ensure development achieves sustainable outcomes and that diversity of urban environments is protected. See INTEGRATE WITH NATURE (Principle 5)

**Strategies**

1. Identify the cultural, environmental and historical values of the sub-region. These values should be preserved and referred to in the Desirable Environmental Outcomes (DEOs) of all planning schemes. Such elements will be enhanced if they are integrated throughout the vision and provisions of planning schemes.

2. Identify and develop provisions to protect critical natural features including waterways, wetlands, stands of vegetation and linkages between these sites as part of the process of identifying areas suitable for urban development. See ENSURE OPEN SPACE DIVERSITY (Principle 8)

3. Develop a comprehensive profile of the environmental, cultural and historical values that significantly contribute to the sub-regional character and identity.

Information provided in the sub-regional profile will assist in the preparation of planning schemes and amendments, environmental impact assessment and subsequent decision-making processes related to the assessment of a development application. A sub-regional profile identifies:

- specific climatic characteristics including *diurnal range* and annual temperature variations, wind patterns, precipitation patterns and humidity
- environmental diversity of the sub-region
- significant scenic amenity areas
- cultural heritage significance and cultural landscape pattern
- localities that reveal and celebrate features of the unique subtropical character and lifestyle
- regional and local outdoor recreational areas
- nature conservation areas
- water sources and catchments
- coastal and marine resources.

4. Maintain the diversity in the urban character and identity of the region’s cities and major centres through attention to climate and landscape, and lifestyle preferences.

5. Maintain the distinctive character of small urban communities and townships, including the scale and built form of the main street, street tree planting, awnings, parks, signage and township entry and exit statements.
Significant topographical features such as mountain ranges and rivers naturally define settlement form and planning boundaries – maintain tree cover on steep slopes of significant ranges.

High points such as hills and ridge lines are easily identified in the overall city-scape and are ideal locations for maximizing natural ventilation.
Significant topographical features such as mountain ranges and rivers naturally define settlement form and planning boundaries. Views and vistas to these major defining elements are an important means of people’s visual connection with their surroundings, and represent long-term community values. These places of cultural and natural heritage contribute to the identifiable character of SEQ.

Planning schemes that identify specific landscape features and natural processes at the outset will help satisfy both amenity and development values in urbanising areas. Development that responds to natural processes will retain the natural beauty and ecological integrity of the landscape for public and private good. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9)

Strategies
1. Identify regionally significant ranges, ridges, mountain slopes and water courses. Protect them from land uses that would change local character or destroy scenic views for the community at large.

2. Identify major public view corridors and vistas to regionally significant features in order to protect scenic amenity values. The SEQ DIP Implementation Guideline No 8, Identifying and protecting scenic amenity values, Sept 2007, available on-line, describes how to go about this process. Generally:
   • Maintain forest cover on ridgelines and steep slopes.
   • Development on lower slopes of significant ridges and hills should not obstruct views of mountain tops or ridgelines from the surrounding roads, neighbourhoods and significant viewpoints.
   • Development on upper slopes should not interrupt the skyline when viewed from the valley.

3. Identify locally important areas of natural scenic value, ecological significance, including natural corridors and wildlife habitats to reveal areas most suitable for conservation or non-urban uses, and those most suitable for urban development.

4. Work with topographical form as a design driver and an opportunity to achieve connectivity and amenity. For example, while significant mountain ranges frame and form the backdrop to settlement, other high points such as lower hills and ridgelines may be more suitable for urban use, and provide locations for key urban centres, crossroads, parks and open space.
   • Climatic benefit. In urban areas, ridgeline positions and the windward sides of hills offer best opportunities for cross-ventilation of buildings and open spaces. See INTEGRATE WITH NATURE (Principle 5)
   • Urban legibility. In the compact subtropical city, transit-oriented centres may benefit from ridgeline locations which make them easily visible and identifiable, by residents and visitors, as coherent parts of the urban public transport network. However, building and infrastructure landmarks must be of a quality which can be perceived as making a positive contribution to urban character. See DIVERSIFY THE BUILT ENVIRONMENT (Principle 3) and CONSIDER LOCAL CHARACTER AND DESIGN (Principle 4)
   • In broadhectare developments, analyse topography and natural drainage processes to reveal the optimal pattern of development.
   • Retain natural terrain as a design constraint, rather than as a problem to be solved by demolition and large-scale earthworks.
   • Locate neighbourhood collector streets along ridgelines, hilltops or riparian corridors.
   • Position roadways, pathways and subdivision layouts in accordance with natural contours as much as possible. See INTEGRATE WITH NATURE (Principle 5)
   • Locate linear, connected open space, local recreation zones, cycle ways and neighbourhood parks along the edges of the natural drainage systems. See USE VEGETATION (Principle 7), ENSURE OPEN SPACE DIVERSITY (Principle 8), INCORPORATE ACCESS TO OPEN SPACE (Principle 9) and DESIGN FOR WATER (Principle 10)
   • Walkable journeys. Take into account the physical realities of walking hilly topography in heat and humidity by providing convenient, shaded pathways for pedestrian movement patterns. In hilly urban areas, the urban design yardstick of the 400-metre, ‘five-minute’ walk should be modified to 300 metres or less, depending on the steepness of the terrain. Street crossings and public transport stops should be spaced more closely for pedestrians’
The average distance that can be covered in five minutes depends on the steepness of the terrain and other conditions such as weather and the walker’s abilities.

Absorb slope within site rather than on boundaries.

Retaining walls and fences on hillsides combine to block access to breeze.
convenience. See fig.1 opposite.

5. On individual sites, preserve the local ecology by minimising cutting and filling on slopes. Integrate landscape design with the development on a hillside to accentuate the unique natural features and to reinforce the stability of a slope.

- When benching slopes for home sites, absorb slope within the site to reduce the height of retaining walls on site boundaries. Climatic advantages of access to breezes on hillsides are diminished when retaining walls and boundary fences exceed the height of openings in buildings. See INTEGRATE WITH NATURE (Principle 5) See figures 2 and 3

The ‘walkable journey’ in subtropical summers requires shade and shelter, and more closely spaced street crossings and stops for public transport.

Cutting into sloping sites destroys the local ecology and reduces opportunities for natural ventilation and connection to the site.

fig.3
Places are meaningful because of the activities going on there.

fig.5

Local bus

Local walking and cycling tracks

Local walking and cycling tracks

Local bus

Local distributor road

Blue shading indicates denser housing overlooking green spaces

Light rail, main bus route

Local bus
The complexity created by diversity is often described as a feature of high-quality built environments, and this has a direct influence on people's sense of a particular place. Places are meaningful because of the activities going on there. Where the quality of the urban environment is poor, activities which are particularly dependent on favourable physical conditions either never develop, or disappear. The design and form of the city must support the ordinary yet necessary aspects of everyday city life, such as daily journeys to and from work.

In the subtropical city, the arrangement of land uses, built form, and vegetation, together with topography, has perceptible impacts on the urban climate, and therefore on the comfort and quality of place. Traditionally, urban settlements in warm humid climates are characterised by buildings which are spaced apart to allow the easy flow of breeze between them, ensuring air movement through open external public spaces such as streets and squares. This 'permeable' urban form, where separate buildings are interspersed with open space and vegetation, is a natural response to climate. See INTEGRATE WITH NATURE (Principle 5)

As well as climatic benefits, a range of densities and building scales give legibility to the urban structure when they are directly related to the anatomy of the city. A cross-section through a city, from city centre to urban, suburban, and neighbourhood settings, should reveal a direct relationship between densities and location. For example, key transit-oriented precincts and corridors should be able to be ‘read’ in the overall city-scape by the scale and density of the buildings which denote them.

Diverse well-planned urban environments, where built form is compatible with landscape, enhance urban connectivity and provide measurable energy savings. See RESPECT TOPOGRAPHY (Principle 2)

Strategies

1. Focus on maintaining both openness and permeability, and a strong connection with nature, in multifunctional, consolidated environments, where not only the skyline reflects subtropical values, but the fine grain of the city does as well. See figures 1 and 2

2. Purposefully apply diversity at the scale of the city core and frame, scale of streets and public open spaces and at the scale of individual developments, to create economically vibrant, safe, attractive and walkable places. See fig.3

3. Permeable urban form in the subtropical built environment has dual roles: it promotes air movement in the spaces between buildings and facilitates ease of pedestrian movement.
   • Promote small urban blocks that allow pedestrians to move with ease and convenience, giving alternative choices or routes to follow, and bringing street crossings closer together. See figures 4 and 5 (opposite)

4. Locate denser housing forms overlooking green spaces, within easy walking distance of public transport. See fig.5 opposite.

5. Add density to existing neighbourhoods by creating sites for multi-residential buildings at the ends of existing urban blocks, where there is the potential to ‘borrow’ green spaces from established rear gardens in the block, and maintain access to breezes for existing and infill dwellings. See fig.6 overleaf.

6. Optimise solar access and air movement to external spaces through design of type, heights and denseness of built form. See INTEGRATE WITH NATURE (Principle 5)

7. For tall buildings:
   • Take into account the conundrum which is posed by the desire to increase density by encouraging tall buildings on the one hand, and the desire to create public spaces which encourage pedestrian traffic and outdoor stays on the other. If not carefully designed, tall buildings have the potential to generate unwelcome microclimates, such as windswept plazas and windy streets, which discourage lively use. Shade produced by tall buildings can protect surrounding spaces and other buildings from the heat of the sun in summer months, or it can exclude the sun’s light and warmth from public spaces in the cooler months. See fig.7 overleaf.
New sites for housing may be created at the ends of blocks.

Subtropical perimeter block

Street elevation

Block section

Fig. 6

Fig. 10

Fig. 7

Fig. 11

Fig. 15

Fig. 19

Diverse the built environment

Pocket parks

Hot afternoon sun blocked

Higher buildings to south and west

Warm winter sun to courtyard

Summer afternoon, courtyard shaded

Winter afternoon, courtyard in sun

noon summer

noon winter
Therefore:

• Apply the core subtropical identity values of permeability and openness to the concept of tall buildings to find innovative solutions to overcome microclimate problems and deliver the qualities desired for the public spaces at ground level. See figures 8 and 9

• Use modelling to optimise the design of a building’s height, scale, form and texture, and juxtaposition to other buildings or trees to benefit air movement and solar access at ground level, and above, to encourage lively streets and reduce potential energy load on buildings.

8. Urban perimeter blocks allow very high urban densities to be achieved while addressing street frontages and facilitating breezes and views.

For the subtropical perimeter block:

• Fragment the edges of the perimeter block. Avoid impenetrable long-wall development that constrains channelling of fresh breezes into urban open spaces. This is particularly important for developments occurring adjacent to large natural water bodies such as lake shores, river banks and ocean beaches, where onshore breezes can benefit whole communities, not just those on the front. See fig.10 opposite.

• Increase density of the buildings towards the west by locating taller buildings on the south-west and west sides of the block. This optimises solar access to inner courts during cooler months and the shading potential provided by the buildings during the summer months. See fig.11 opposite.

• Ensure there are deep soil areas within street frontages and within courtyards so that substantial subtropical trees can be established on site. See figures 12 and 13

• Create mid-block open spaces that provide cool shade in summer and are protected from cold winds in winter. See fig.14

• Create north-east and north-west corner pocket parks and mid-block open space to channel cooling breezes in the hottest afternoon hours during the summer months. See fig.15 opposite.

• Develop convenient and sheltered pedestrian connections through the urban block, independent of street pattern, such as arcades, covered links, outdoor rooms. See DEVELOP OUTDOOR CENTRES (principle 12) See figures 16, 17 and 18

• Well located and designed water features increase passive cooling and enhance the quality of public spaces. See fig.19 opposite.
Hillsides of trees: the pattern of development illustrates the balance between topography, vegetation and built form.

Cities and suburbs are indistinguishable from place to place.
“As a location’s most endemic factor, climate provides the designer with a legitimate starting point for architectural expression in the endeavour to design in relation to place”. Yeang, 1996

Globalisation, urban sprawl and alienation of local knowledge from urban development practices have resulted in ‘placelessness’. Cities and suburbs in many parts of the world are almost indistinguishable from each other. Commercial towers, multi-lane freeways, airports, sports stadia, shopping centres, streets and dwellings, have strong similarities no matter where they are located.

PART TWO of this handbook describes regional values which underline the character and identity of SEQ as a ‘sense of openness and permeability’ and a ‘strong connection with the natural environment’. In the context of subtropical SEQ, these values can inform sustainable solutions to questions of built environment planning and place design.

Discrete areas within SEQ also have particular attributes and locally appropriate responses to sub-regional landscapes, lifestyles and climate variations. See RECOGNISE SUB-REGIONS (Principle 1) and INTEGRATE WITH NATURE (Principle 5).

As well, people may identify with character which is idiosyncratic to a neighbourhood. Local character may derive from the cumulative effect of a combination of qualities, for example:

- presence of notable features or characteristics of the natural or built environment, for example landmark trees or geological forms, or historic structures
- locally distinctive flora or wildlife
- sounds associated with local features
- aromas associated with local features
- relationship between topography and built form
- patterns of development
- scale of buildings and scale of vegetation
- vernacular structures and architectural styles
- local community preferences for lifestyle and recreation.

Considering traditional buildings in particular, much of the shared concept of character and identity in SEQ is influenced by the visual and textural qualities that are a result of the play of light and shade on three-dimensional forms and materials. Deep shadows and recesses contrasted with wall and roof planes in full sunlight evoke an impression of comfortable shelter from the elements. The interplay of structures and materials with foliage is a major contributing element.

Qualities such as partial shade, filtered light, screens that give a sense of enclosure yet let breezes pass through and allow the occupant to look out, are intrinsic to Queensland vernacular buildings. Materials commonly used in vernacular and architectural styles such as corrugated metal sheet and timber weatherboards also make a potent contribution to a sense of coherent identity, particularly through the visual textures which their profiles produce in the form of shadow lines and pattern making.

However, respecting the local character of a place does not mean imitating traditional building styles, nor does it prevent the application of contemporary design approaches and materials. Contemporary design which takes its cues from the desirable qualities of the traditional vernacular, without replicating actual styles of past eras, will produce more successful models of sustainable development.

**Strategies**

1. Use the local collective sensibility to capture the essence of the character of the local context and foster a sense of place.
   - Identify and recognise the combination of forms and textures and other cues that contribute to distinctive character of a local area.
   - Identify, assess, and protect historically and culturally significant plants, integrating them within the overall site design, taking care to locate buildings and infrastructure in a way that does not endanger them. See USE VEGETATION (Principle 7)
   - Identify and keep ‘alive’ significant historical buildings, successful public places, streets, subtropical gardens and parks which contribute to a locality’s liveability.
Translucent material overhead lets in light and provides weather protection to semi-outdoor areas.

Contemporary design takes its cues from desirable qualities of traditional vernacular.

Contemporary forms and materials are valid in the subtropical environment.
2. Recognise the contribution of vernacular structures to the character of their neighbourhoods. Safeguard authenticity in existing areas by allowing for dynamic changes in use of vernacular structures over time. See fig. 1 See DIVERSIFY THE BUILT ENVIRONMENT (Principle 3)

3. Use scale and materials, rather than prescribed styles, to enhance the expression of the local character in the design of buildings and public outdoor spaces. See fig. 2

4. Contemporary technologies and materials offer designers much wider possibilities for achieving both powerful sensory qualities which enhance character and identity, and for applying the appropriate materials for proposed forms and applications.
   - Select materials according to suitability for purpose, but informed by desired qualities of character and identity. Take into account wind resistance and structural implications, desired level of light transmission (day and/or night), desired level of solar heat gain, degree of water-tightness, life span, relative cost, and maintenance implications. See fig. 3
   - Be aware of the effect of subtropical weather and environmental elements on materials; wind and sun, salt, and dust cause corrosion, discolouration, and clouding of many types of materials. Specifications for materials vary widely according to the context and function. For example, an organic material such as timber, a material that typifies local identity, deteriorates rapidly if not protected from the weather through appropriate construction details. See fig. 4

5. Use materials which are both suitable for the specified application and can contribute to the comfort and sustainability of the urban environment.
   - A massive material such as concrete absorbs and stores heat. When unshaded expanses of concrete are used on external surfaces surrounding buildings, such as open car parks and driveways, heat and glare are re-radiated into adjacent internal spaces, and add to the general overheated ambience of a public space. Concrete used as a ground surface in this way is also impermeable and encourages overland flow of stormwater to build up rapidly during rain; then, warm, contaminated water is delivered rapidly into waterways. Instead, select paving materials that are porous to allow stormwater to percolate into the ground more slowly to recharge aquifers, and lessen the effect of heat and glare. See INTEGRATE WITH NATURE (Principle 5) and DESIGN FOR WATER (Principle 10). See figures 5 and 6 (opposite).
   - Weather protection is essential in public spaces in the subtropical urban environment. While traditional materials for awnings were opaque, contemporary materials which admit light and deny access to harmful solar ultraviolet radiation (UVR) (the cause of most skin cancers) are available in many forms for a wide variety of applications. Some exclude unwanted heat while others do not. See fig. 7 opposite.

6. Where possible, use locally sourced materials that complement local character; for example, demolition materials may be reused, or recycled for new applications.

7. Providing their selection is based on sound environmental reasoning and is informed by the overarching values of subtropical place and identity, non-traditional materials (such as fabrics which may be knitted, woven, or solid; metal meshes; lightweight and strong fibre composites; glazing that can block heat or light, or double as a solar collectors) may find appropriate application in the contemporary subtropical city to contribute to a diverse and dynamic built environment. See fig. 8 opposite.
In warm humid subtropical cities like Brisbane, buildings spaced apart allow for easy flow of wind through spaces.

A dance hall in South Brisbane benefits from abundant natural light and cross-ventilation assisted by large canvas fans swinging from the ceiling.

In warm dry subtropical cities like Barcelona, buildings which are close together shade each other and streets.
The natural attributes of the subtropical climate offer great advantages to urban planners and designers of buildings and open spaces. To create new approaches to urbanism and infrastructure, planning and design must:

- support local character and identity through planning and design. See **CONSIDER LOCAL CHARACTER AND DESIGN** (Principle 4)
- support walkable and accessible streets and public spaces. See **INCORPORATE ACCESS TO OPEN SPACE** (Principle 9) and **DEVELOP OUTDOOR CENTRES** (Principle 11)
- mitigate negative urban climate impacts of global climate change
- adapt to the impacts of global climate change
- dramatically reduce resource consumption and carbon emissions.

This principle is about understanding the link between lifestyle and climate and how design that encourages living with our climate, rather than locking ourselves away from it, can achieve solutions that are climate responsive, resource conscious, water sensitive and values sensitive.

Importantly, subtropical design thinking must lead land-use and infrastructure planning in decisions about what, where, and how to build. It is applicable at all scales of development including buildings.

Subtropical design is integral to all scales of development in subtropical regions and is neither an ‘added extra’, nor a superficial style.

**Strategies**

1. The humid nature of the SEQ climate has a critical bearing on the form of urban settlement most suitable for favourable liveability and low-energy outcomes. The effect of humidity on human comfort is most noticeable when air temperature is high and air movement is low.

- Whereas urban settlements in warm dry climates benefit from urban form where closely-placed buildings shade each other and streets from the direct sun, cities in warm-humid climates need openness and permeability to allow for the easy flow of wind through spaces between buildings and through buildings themselves. See **figures 1 and 2 opposite**.
- The warm-humid SEQ city of the future needs to be compact, yet remain open and permeable. This means that buildings should be spaced apart, yet not isolated from one another. The space between buildings should be considered as positive urban space supporting a range of activities such as connecting buildings with covered arcades and courtyards. See **fig.3**
- SEQ’s coastal strip experiences milder temperatures than areas further inland in the region, because of the moderating effect of the ocean. Locations further from the coast tend to be warmer in summer and cooler in winter than those on the coast, and, significantly, cooling breezes are less prevalent in inland areas. See **RECOGNISE SUB-REGIONS** (Principle 1)
- In the complex process of determining the suitability of land for urbanisation, the availability of wind must be considered for its likely effect on built form and on the demand for energy to achieve *thermal comfort* in buildings. However, notwithstanding individual weather events, typical conditions vary from strong winds in coastal locations to very light air movement in inland locations.
- In all locations, solar *orientation*, slope and surrounding terrain combine to influence the potential for buildings and public spaces to benefit from natural ventilation. Where possible, use north to east-facing slopes, and complement densely populated urban areas with nearby vegetation and large bodies of water. See **Strategy 6 for more detail**. See **fig.4**

2. Knowledge of the sun’s path is essential for planning and assessing the effectiveness of passive climatic design strategies. Areas of open space or buildings affected by sunshine and shadow vary daily according to the time of the year. However, there is no guesswork necessary to predict where a tree or structure will cast its shadow, or where solar access will be gained. Solar charts are widely published and software applications are readily available which can map and model the effect of the sun’s path on a given site, and these should be used to optimise planning of urban structure and form. Important facts are:

- The sun is lower in the sky during the six months from late March until late September and penetrates deeper under awnings and into buildings and casts longer shadows.
- The sun is higher in the sky from late September until late March and casts shorter shadows.
North-south streets are ideal for pedestrian links, and east-west streets support public transport, public open spaces and traffic.

Wind speeds are highest near the top and sides of hilltops, on the windward side. The lowest speeds are near the bottom of the hill.

Northern slopes may be appropriate for higher densities and taller buildings.

Southern slopes are not ideal for breezes or solar access.
and can easily be prevented from entering spaces on the north side by overhead shade.

3. Outdoors, shade from direct sun or shelter from chilly winds contributes to how comfortable people feel. Human comfort is an important urban design objective for the compact subtropical city. Public places that are comfortable to be in most of the time will be used more frequently and for a greater variety of activities, from the necessary (e.g. daily journeys to workplaces) to the optional (lunchbreak in the outdoors). See ENSURE OPEN SPACE DIVERSITY (Principle 8)

Shaded footways integrated into the urban fabric encourage walking and contribute to accessibility of public transport, public places and local recreational facilities.

- For successful pathways, take into account the relationship between desirable pedestrian movement patterns and the path of the sun. When shade coincides with the time of day that most people are likely to use a route, more people will benefit and the uptake of walkable journeys will increase.

See INCORPORATE ACCESS TO OPEN SPACE (Principle 9) See figures 5 and 6

- North-south running streets offer ideal orientation for pedestrian links because the buildings and trees lining each side provide shade in the early morning on one side of the street, and in the late afternoon on the other. This works for summer commuters seeking a shaded pathway to transit stops. In winter, commuters can take advantage of the sunny side of the street. Substantial street trees also shade the buildings which have frontages to the east or west. See fig.7 opposite.

- Make east-west running streets wider and create an active public environment, allowing arcades or other shading structures along each side. The streets of this orientation should be multifunctional and accommodate bikeways, public transport or some casual parking.

See ENSURE OPEN SPACE DIVERSITY (Principle 8) and USE VEGETATION (Principle 7) See fig.8 opposite.

4. Some of the points in Strategy 3 may seem unattainable where urban development is established and the existing street layout is not ideally oriented. However, master planning for infill developments that increases densities and mix of uses around transit-oriented development precincts and activity centres offers an ideal opportunity to replace unsuitable urban patterns. What is needed are orientations for streets and urban open space that will be more conducive to supporting lively public spaces.

5. Where transport infrastructure in the compact subtropical city requires passenger stations and interchanges to be below ground level, the values of openness, permeability and connection to nature call for particular attention. Use climatic design, particularly knowledge of orientation, to bring natural light and ventilation to subterranean transport concourses. See fig.9

6. The combination of the orientation of topographic features and the disposition of buildings relative to other buildings are important variables in climate-responsive design. New neighbourhoods and communities in greenfield areas can balance parameters, including the mix of densities and arrangement of lots, to optimise potential for solar access and to beneficial breezes for open spaces and buildings.

- Determine lot orientations and boundary setbacks by taking local terrain into account. Hill shapes and slopes, and adjacent ridges and gullies, are all influential on local microclimate effects. Some of these are outlined in the following points; however, the constraints and design possibilities of any greenfield potential urban site must be subject to detailed climatic analysis.

- Hillsides which give access to breezes are desirable locations for residential development in humid subtropical places. Higher rates of air movement occur near the hilltop on the windward side. Winds are strongest at the top and sides of the crest of the hill, and wind speeds are lowest near the bottom of the hill. The leeward side of hill is generally in a ‘wind shadow’ where there is no breeze. See fig.10 opposite.

- North-facing slopes offer high potential for both natural ventilation and solar access to buildings. See Strategy 7 for more detail. As buildings and trees on north-facing slopes cast shorter shadows than they would on flat land, taller buildings may be appropriate on these slopes, providing that allotments are deep enough to allow air and sun access to buildings further up the slope. Note: this strategy does not advocate building where the slope is
Around Brisbane, sun entry is desirable from mid April to mid October. A moveable shade device should be used on north-facing openings to exclude sun entry from mid October to mid April.

Air movement is greatest where large openings of equal size are placed opposite each other.

Air speed increases when a small inlet is combined with a large outlet.

A large inlet combined with a small outlet has little cooling effect inside the building.

Cross-ventilation requires openings for inlet and outlet.
excessive, or prone to erosion or slippage. See fig.11 page 28.

- Southern slopes provide less favourable sites for residential uses as they are likely to be in the lee of summer breezes and prone to adverse winter air currents. Access to the sun is also reduced, particularly from April to September when the sun is lower in the sky. Southern slopes require allotments to be deeper on a north-south axis so that buildings further down the slope receive appropriate solar access. See fig.12 page 28.

- Discretion is needed in decisions about whether to develop on west-facing slopes. As well as being exposed to hot afternoon sun, western slopes are often on the leeward side of hills and receive little or no breeze in summer, but are exposed to cold westerly winds in winter. However, some locations offer spectacular views to the west particularly at sunset. Exemplary building design is obligatory to take advantage of this without compromising the liveability and energy performance of buildings. In the first instance, layout of lots requires careful positioning to produce building sites that allow buildings to open up to the north with due consideration for privacy. Effective space for shade trees on the western boundary is also essential. See fig.13 opposite.

- East-facing slopes have greater potential for natural ventilation, particularly if the north to north-eastern aspect can be maximised for buildings. The east slope is also protected from winter westerly winds.

- Ensure that planning for residential development on hillsides takes climatic advantages of topography into account. Ensure that space is set aside for shade trees to benefit both buildings and pathways. See USE VEGETATION (Principle 7) Minimise heights of retaining walls on site boundaries. See RESPECT TOPOGRAPHY (Principle 2)

7. Once the parameters outlined in Strategies 3 and 6 are in place, climatic design principles may be applied to individual buildings. In order to reduce occupants’ reliance on energy, strategies for sun control, air movement and the building’s shape and materials are all interrelated and need to be in balance and duly considered with matters such as privacy and territoriality. No ideal solution is likely under practical circumstances; however the following recommendations are ‘rules of thumb’ to help planners and developers arrive at an acceptable compromise.

Take into account the specific characteristics of sub-regional climates when applying climatic design principles. For example, in inland areas, strategies which generate the cooling effect of breezes to compensate for low air movement are essential, while in coastal areas ways of moderating strong winds are important. The further from the coast, the greater the range of air temperatures that must be considered.

**Design recommendations for solar control:**

- The northern orientation is the easiest to control in terms of solar access, and is recommended for living areas or spaces used throughout the day. See fig.14 opposite.
- Use narrow floor plans with the long side facing north. Combined with the correct location and sizing of openings, this strategy can successfully combine sun control, daylight entry and airflow through a building. Western and eastern faces should be kept to a minimum.
- Direct sun entering covered or enclosed spaces affects the radiation of heat into these spaces. Summer sun should be excluded and warm sunshine welcomed in the cooler period of the year. Natural light to interiors is important throughout the year, both for energy-saving and for feelings of well-being. See fig.15 opposite.
- Plant shade trees on the western and eastern sides of properties. Shade trees are also beneficial on the northern side but careful consideration must be given to tree height, distance from the building and whether they are evergreen or deciduous. Evergreen trees may block sun entry in winter and unnecessarily increase electricity used for heating and day lighting. Trees on the southern side of buildings also need to be considered carefully in similar terms. See USE VEGETATION (Principle 7) See fig.16 opposite.

**Design recommendations for natural ventilation:**

- Narrow floor plans are most effective. See fig.14 opposite.
- Cross-ventilation requires both inlet and outlet openings. Maximum airflow occurs where large openings of equal size are placed opposite each other. Other opening positions achieve other effects. Determine ideal size and location of window and door openings through detailed architectural layout. See fig.17 opposite.
Achieve a rich transition from indoor to outdoor spaces with large windows and doors opening onto shaded verandahs and terraces. See fig.18

Good cross-ventilation can be achieved with louvres or other window systems that hinge or pivot to allow full use of the available opening. These types of windows also offer the advantage of being able to be adjusted to regulate wind speed and direction. See figures 19 and 20

This strategy can be used to advantage in the design of ‘privacy’ screens that are required to prevent overlooking. Often poorly considered, these devices prevent effective natural ventilation. Instead of blocking air movement, privacy screens can act as wind scoops, improving ventilation and airflow rates for occupants, and improving privacy for both occupants and neighbours. See figures 21 and 22

Let heat and moisture escape at the highest part of the roof. Ridge vents running perpendicular to the summer winds, and clerestories or vented skylights are recommended. See fig.23 opposite.

These devices can also be used to take advantage of cooler night-time temperatures to draw in cool air and flush out warm air.

Devices such as ‘wing walls’ direct airflow through spaces, creating positive and negative pressure zones. Vegetation can also be used to good effect in this way. See fig.24 opposite.

Wind ‘scoops’ can be integrated to enhance ventilation rates and directions by creating a ‘chimney’ effect. The higher the scoop above the general roof line, the better. See fig.23 opposite.

Coastal areas are often the habitat of biting insects, and their effect is often most noticeable when wind velocity is low, or at dusk or high tide. Insect screens must be integrated but can reduce airflow by a substantial amount. Where possible make screens retractable for those times when they are not required.

Use fans to assist air-movement strategies.

Avoid high fences that block breezes. See fig.25

Cross-ventilate corridors and other circulation spaces in apartment buildings.

Achieve permeability in buildings by breaking floor plans into smaller segments with covered connections between. This strategy can also be used to isolate heat-generating functions from other uses.

**Design recommendations for materials selection:**

- Provide cooling paths for breezes entering buildings by keeping external surfaces shaded. Use pervious surfaces or groundcover planting instead of hard paving materials. See fig.26
- Massive materials such as concrete floors or masonry walls modulate the internal environment as long as they are fully shaded on summer days.
- Materials that admit sunlight but exclude the sun’s heat are useful for walls and roofs to decks, without making adjacent interiors too dark during the day. See page 24 fig.7.

**fig.18**

**fig.19**

**fig.20**

**fig.21**

Breezes are blocked when screens are not carefully designed.

**fig.22**

Adjustable screens can block sun when it is needed and provide privacy for both occupants and neighbours.

**fig.23**

Houses and garden coexist. Planting between buildings provides visual privacy, and porous ground surfaces absorb rainfall and do not obstruct overland flow of water.

**fig.24**

**fig.25**

**fig.26**
Make balconies deep enough to gather around a table.

Balconies that are too small and too exposed do not support outdoor living.
Outdoor living, the benign climate, and the close proximity of natural and rural environments have fostered a strong sense of informality in the subtropical lifestyle.

The relaxed quality of urban living has become a part of the regional identity of subtropical Queensland. The informality valued by our community is reflected in the built environment by the outdoor places that provide shelter and settings for many activities, which in other climates might be compelled to take place indoors.

At the centre of this principle is the desire to maintain and enhance the visual and physical connection between the urban footprint and the natural surroundings; and for the city dweller to value the sensibilities of the beach or the country, in the city. See ENSURE OPEN SPACE DIVERSITY (Principle 8), INCORPORATE ACCESS TO OPEN SPACE (Principle 9) and DEVELOP OUTDOOR CENTRES (Principle 11)

**Strategies**

1. Create inter-urban breaks between urban areas to enhance the local character of each and contribute to the sense of informality of the environment. Inter-urban breaks may range in scale, and should be integrated into subregional breaks to form a network of regional open spaces.

2. Allow nature to penetrate into the urban fabric. ‘Green’ the city and incorporate natural elements within urban developments using water-sensitive urban design principles. For example, less formal approaches to street design could use pervious rather than impervious ground surfaces, and replace kerbing with soft edges. Stormwater run-off supports shade-giving vegetation. Several benefits of this approach include ‘traffic calming’, improved micro-climatic conditions, and sustainable management of stormwater. See fig.1

3. Acknowledge that trees that grow well in the subtropics often have unruly growing habits. Ensure that urban trees have the space they need to thrive so that the community may benefit from the microclimatic and other ecosystem services they can provide. See fig.2

4. Support the desire for outdoor living through attention to the design of private outdoor spaces in higher density living environments. See fig.3
   - Balconies or terraces must offer direct and useful connection with life indoors.
   - A sense of openness should be achieved through providing partial enclosure. Fully transparent balustrades are not recommended because they discourage people from making full use of both the balcony and the adjoining living spaces.
   - Balconies which are partially recessed rather than projecting fully beyond the line of the building give users a better sense of privacy and utility. See fig.4
   - Balconies must be deep enough for people to gather around a table. See fig.5 opposite.

5. While not strictly a planning strategy, the following suggestions for cultural change have implications for carbon emissions reductions and precinct and building design:
   - Abandon the formality of the business suit during the subtropical summer. The insulating effect of this type of clothing in the office environment perpetuates internal climate conditions in commercial office buildings which contrast strongly with the naturally benign outdoor conditions and require large expenditures of energy for air-conditioning all year round.
   - Significant savings in energy, water, greenhouse gas emissions, and energy costs can be made through adjustments to thermostats, while maintaining acceptable levels of comfort, in both summer and winter.

Use porous ground surfaces rather than hard paving.
Foliage and vegetation are at the heart of SEQ’s character and identity, and play a crucial role in the sustainable subtropical urban place.

fig.1

- Higher density residential dwellings overlook green areas
- Large shade trees flourish in spaces between buildings
- Streets form the edges of green areas
- Urban centres are in close proximity to accessible green areas

fig.4

Provide unobstructed growing space above and below ground.

fig.5

Overlapping canopies provide continuous shade cover on tree-lined streets.
In the SEQ context, an emphasis on foliage and vegetation offers great opportunities for evoking a sense of place, which is both instantly recognisable and part of our landscape heritage. Textural contrasts, scents and perfumes and swathes of colour in flowering season contribute to sensory delight.

As well as offering place-identity values, trees and green spaces are essential for the healthy ecology of the subtropical city. Well-planned and maintained vegetation supports urban wildlife and flora, helps manage stormwater quantity and quality, modifies air quality by acting as a dust filter, and is perceived to take the edge off ambient noise. Vegetation can also enhance views or increase visual privacy between buildings. Several studies have shown that access to trees and green areas in urban environments can increase people’s physical and mental well-being. More and more people value home-grown fruit, vegetables and flowers. The opportunity to grow plants must be available to future city dwellers as well.

Vegetation benefits carbon emissions reductions in two significant ways: firstly through direct absorption and sequestration of CO₂ by the growing tree; secondly by contributing to energy conservation. Well-placed vegetation can reduce demand for electricity, and cool buildings through shade and by controlling air movement around and through places and spaces. Significantly, these factors contribute to moderating the ‘urban heat island’ effect. Outdoor places with shade are far more viable than those without. See INTEGRATE WITH NATURE (Principle 5)

Given the microclimate benefits afforded by trees and other forms of vegetation, urban growth should embrace strategies to ensure urban vegetation is promoted and nurtured, particularly if the aspirations for walkable journeys in a compact environment are to be realised.

Strategies

1. Value the ecosystem services provided by existing urban trees and preserve significant shade trees as valuable community assets. See CONSIDER LOCAL CHARACTER AND DESIGN (Principle 7)

2. Accompany increasing levels of urban consolidation with increasing consolidation of urban tree cover. Dense development adjacent to significant green areas creates urban amenity.
   - Conceptualise vegetated areas as contiguous green space. See fig.1 opposite.
   - Urban centres, community facilities and parks are positioned in locations such as ridgelines and hill tops, adjacent to riparian corridors, or stands of significant vegetation, where the buildings overlook green areas.
   - Green areas have public frontages, with streets forming the edge. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9)
   - Allow large shade trees to flourish in both private and public spaces throughout the city, from major transit-oriented activity centres to suburban neighbourhoods. See fig.2
   - Make informed decisions based on factual information rather than alarmist assumptions with respect to the safety of tall trees in an urban environment.
   - Identify existing biodiversity corridors to ensure new and infill developments have positive links into these.

3. ‘Green’ transport corridors. Incorporate vegetation types which respect local values into planned and existing transport corridors including rail corridors, freeways, motorways and busways. See fig.3

4. Ensure planned and existing trees and vegetation can flourish and be resilient to climatic aberrations such as prolonged dry weather or heavy downpours. Adopt water-sensitive urban design principles.
   - Promote longevity of trees by providing sufficient unobstructed growing space above and below ground. Ensure soil quality to allow for the mature growth of vegetation planted in it. See fig.4 opposite.

5. Make tree-lined streets the norm. Provide continuous tree cover along footpaths in existing and new developments. See fig.5 opposite.
   - Incorporate avenue planting in street design. This not only creates memorable streets and provides shade to the road surface but also decreases ambient air temperature. See fig.6
   - Choose trees with broad spreading canopies that overlap with each other or with shade-
Narrow spaces on boundaries create unfavourable microclimates for planting.

On small residential lots maximise outdoor space on the northern side by building to the boundary on adjacent lots.

Carefully consider height and type of trees on northern side.

Trees on west and south-west block hot afternoon sun. Deciduous trees admit sun in winter.

Shady trees and pergolas promote cool pathways for breezes entering buildings.
giving structures where practical.  See figures 7 and 8 opposite.

- Use planting that has a mixture of layers, shapes, species and colours, including a mixture of native and non-weedy exotics.  See fig.9
- Locate utilities underground in new developments, or when upgrading existing infrastructure.
- Use appropriate technology to protect pavements from the tree roots.  See fig.10
- Use permeable pavements beneath trees up to the drip-line.
- Encourage deep watering strategies that integrate stormwater management.  See DESIGN FOR WATER (Principle 10)

6. Ensure the design of new medium-density and mixed-use developments provides for a net increase in tree cover, on both private land and public land.
- Foster tree planting and continuous vegetation. Plant native trees extensively throughout the built environment, and preserve existing trees during new construction.
- Allow for large shade trees to flourish in private space between buildings.  See fig.11
- Allow for large shade trees to flourish in public space between buildings and streets.  See fig.12
- Development proposals must demonstrate design and construction strategies that support watering and nourishment of substantial vegetation, as in Strategy 5, as well as accounting for pruning and leaf removal.
- Balance building heights and vegetation. Provide sufficient space to ensure trees complement the building form and use.

7. Select shade trees species and locate them relative to buildings to maximise energy conservation, thereby reducing electricity use and reducing greenhouse gas emissions. (Detailed planning for selection and placement of shade trees requires due consideration by qualified designers).  Generally:
- Trees shading the west and south-west of buildings reduce summertime energy demand for cooling by blocking the hot afternoon sun.  See fig.13 opposite.
- Trees shading the eastern sides of buildings cast shadows in the cooler morning hours. However, they are useful for protecting east-facing glazing and therefore can have a positive effect on comfort in enclosed spaces in summer. (They have little effect on winter electricity use, as early morning sun rises north of east and is not obstructed by trees in the east.)
- Trees shading the north of buildings can reduce energy needs in summer by providing cooling. Depending on their height and distance from the building, such trees may need to be deciduous so that electricity use in winter is not increased by demand for warming, and for day lighting.  See fig.14 opposite.
- Trees on the south may increase electricity use, particularly in winter months, if their shade causes people to use artificial lighting during the day.

8. Private plantings make important contributions to streetscapes. Single-storey detached houses that cover much of their site leave very little space for trees or garden plots. The current practice of building a metre or so away from side fences results in spaces on each side of the fence which are hostile for gardening; they are often windy, periods of sunlight are very short and rainfall penetration is diminished. As a result, these narrow passages are likely to be hard paved, further compromising the microclimate surrounding the residence.  See fig.15 opposite.
- On small residential lots, maximise yard space for gardens on the northern side, by building to the boundary on adjacent lots.  See fig.16 opposite.

9. Where private space for optimal placement of shade-giving trees is constrained, such as on small residential lots, use overall neighbourhood planning and street tree planting to optimise microclimatic conditions for dwellings.  See fig.17 opposite.

10. Ensure vegetation promotes rather than prevents breezes and natural ventilation. High shrubs in the subtropics require careful selection and placement to positively influence air movement and develop useful shade.  See INTEGRATE WITH NATURE (Principle 5)

11. Actively encourage ‘green’ walls and ‘green’ rooftops throughout the subtropical city. These have measurable positive impacts on reducing the urban heat island effect in cities through cooling surfaces of walls and roofs exposed to the sun. ‘Green’ walls and ‘green’ roofs complement ground-based vegetation but are not a substitute for urban trees.  See fig.19
Outdoor open space takes on many guises in the subtropical city and is made up of diverse spaces and types, at a range of scales. Open space which is flexible and adaptable to a variety of uses contributes to the social, cultural and recreational life of subtropical communities.
As urban density increases in subtropical regions, it is critical to maintain an adequate balance between built form and outdoor open space, not only to maintain recreational amenity for residents, but also to sustain the permeable settlement pattern which is so essential for air movement in the humid climate. See INTEGRATE WITH NATURE (Principle 5).

A system of open spaces within a subtropical urban area incorporates not only public open space, but also includes semi-public and private open spaces that are linked and interact with one another. This system is made up of diverse places and types, at a range of scales.

As well as ‘green space’ such as parkland and ‘blue space’ (e.g. the ocean, waterways and wetlands), ‘grey spaces’ (e.g. footpaths and thoroughfares, squares and forecourts) are also types of open space. Different types of open space can be characterised as either ‘nodes’ (e.g. parks) or ‘corridors’ (e.g. creeks or waterfronts). Linking these to each other to form a network must be a primary consideration in planning and developing the well-designed subtropical city and region of the future.

Strategically planned open space that provides many functions and services contributes to mitigating and adapting to climate change through a considerable range of environmental, social, and economic benefits. Certain open space functions such as water management, carbon absorption, and local food production, will be ever-increasingly required as population rises.

One of the best opportunities for the future health of subtropical communities is to conceive and design open space to serve multiple ecological functions. See Strategies 2, 3 and 4 below.

**Strategies**

1. Make an open space network a key factor in planning, developing and maintaining subtropical urban settlements. See fig.1 opposite.
   - Use the physical structure of open space in the subtropical city to retain openness and permeability, and strong connection with nature.
   - Conserve key biophysical resources such as environmental corridors and habitats across jurisdictions.
   - Achieve physical and functional connectivity between open space sites (nodes and corridors) at all scales across suburbs, towns, cities and the region.
   - Reflect scenic land and water values, as well as topography, hydrology and drainage in open space nodes and corridors.

2. The subtropical city is distinguished by its green neighbourhoods. Design the network of open spaces to reflect and enhance the area’s heritage and locally distinctive character, including local landscapes and habitats. See USE VEGETATION (Principle 7). See fig.2 opposite.

3. In subtropical humid regions, well-conceived open space can contribute to reductions in greenhouse gas emissions in various ways:
   - The natural cooling provided by open space has the potential to moderate the urban heat island effect, and reduce the need for energy-intensive air-conditioning systems in urban buildings. See fig.3
   - Vegetation associated with open space absorbs and stores CO₂. Ensure that vegetation cover is increased as urban density increases in order to absorb and store more CO₂.
   - The pleasant car-free environments that open spaces provide may persuade people to choose alternatives to driving private motor vehicles (such as walking and cycling) for some trips. A comprehensive and navigable open space network is crucial for these active modes of transport to be effective. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9). See fig.4
   - Using open space for local production of food (e.g. in private or community gardens) or of fibre for other uses, potentially reduces greenhouse gas emissions associated with food production and transportation.

4. Open space that provides for sustainable management of urban stormwater and grey water contributes to a healthy ecology in the subtropical environment. See DESIGN FOR WATER (Principle 10) and ‘Water by Design, 2009’ for water-sensitive urban design techniques.
   - Water-sensitive urban design techniques facilitate urban water management that preserves...
fig.15
Nominate significant streets where one footpath can be a linear park – say three times as wide as standard – for moving and stopping, informal activities, street markets, outdoor dining, exercising, just sitting, or waiting for and catching transport.
the quality of streams, availability of water, promotes healthy urban vegetation and associated wildlife habitats.

- Green spaces can provide an efficient and cost-effective drainage and ‘soak-away’ system to absorb rainfall. This is important for reducing the detrimental effect of rapid run-off of warm, contaminated water from impervious urban surfaces into waterways, and for recharging groundwater.
- Green spaces can provide efficient and cost-effective bioretention and grey water storage. See fig.5

5. One of the most important attributes of outdoor open space is its contribution to the social life of communities. The subtropical climate offers year-round opportunities for casual interactions amongst people in outdoor open space, while opportunities for physical recreation and sport are essential for good population health. The open space network must include:
- Social spaces or informal recreation places that are within close walking distance of most residences and workplaces and can be conveniently accessed and utilised with little preparation (i.e. spontaneously). See fig.6
- Spaces that accommodate more formal recreation that people can access after some preparation and planning. Such spaces need not be immediately accessible but should be convenient to transit routes and stations. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9). See figures 7 and 8
- The success of outdoor open space as social space relies on the amenity provided by their structure and design, taking climate and comfort into account. See DEVELOP OUTDOOR CENTRES (Principle 11) and INTEGRATE WITH NATURE (Principle 5). See fig.9
- Community facilities located within the open space network link community life to the environmental role of urban open space. See fig.10

6. Avoid setting minimum quantitative spatial requirements for outdoor public open space. Without reducing existing public open space, concentrate on increasing availability of open space by improving functionality, accessibility and quality of existing open spaces.
- Good accessibility is one of the most important attributes of urban open space. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9).
- Utilise open space for different but compatible functions on the same site. For example, management of stormwater may be combined with linear parks that function as recreational and natural areas as well as forming part of pedestrian and cycling movement networks. Functions that interact with each other and form part of an integrated network protect and enhance environmental and social values. See figures 11, 12 and 13 opposite.
- Locate multifunctional urban open space within walking distance of residences and workplaces, and public transport stations.

7. Convert under-utilised spaces into multifunctional open spaces.
- For example, the street network currently exists mainly to move car-based traffic quickly. Re-designed as linear greenways, with slower traffic, streets can become an open space resource, with stormwater-fed vegetation providing shade and amenity for social spaces and connectivity. See figures 14 and 15 opposite.
- Post-industrial land can be remediated to become ‘working landscapes’ that capture and store both water and carbon emissions while providing space for outdoor recreation. See figures 16 and 17 opposite.
- Address planning regulations that create marginal space with little utility on medium-high density development sites. Narrow setbacks from side boundaries offer little meaningful outdoor space and as a result are often paved over, creating unfavourable microclimatic effects and spaces that provide no amenity. See USE VEGETATION (Principle 7)
- Retrofit existing suburbs in a way that increases the number of dwellings without reducing land area, such as converting large family houses to multiple dwellings for smaller households, or adding second-floor units to single-storey dwellings.

8. Envision alternative ways of designing and using car parks. Open car parks typically lack the amenity to function as outdoor open spaces, yet occupy much valuable and visible urban land. Typical paving treatments create adverse microclimatic conditions for surrounding buildings and stormwater management conditions that require large-scale engineering. See fig.18 opposite.
- Dedicate minimal land exclusively to parking for private vehicles.
fig.20

Two options for creating four visitor car parks, turning circle and driveway.

**OPTION A**
Design not supporting subtropical design principles

- Existing trees removed
- Forecourt, concrete boundary to boundary
- Pedestrian path
- Driveway
- Large shade tree removed

**OPTION B**
Sustainable subtropical design transforms car parking areas to amenable spaces

- Existing trees retained
- Segmented surface maintains hard stand for vehicles, accommodates trees and lets moisture in
- Large shade tree retained, shade footpath and forecourt

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fig.22

- Solar collectors on roof tops
- Large outdoor living spaces with adjustable screens
- Narrow buildings for natural light and cross ventilation
- Space between buildings for large shade trees
- Rainwater storage
- Cool external surfaces

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Summer sun

Winter sun
• Transform car parks after hours and at weekends to other functions that require large flat surfaces such as basketball or netball courts.
• Design surfaces to be porous yet trafficable.  See fig.19 this page and 20 opposite.
• Use car storage systems that require less space for parking. Devote the space saved to usable outdoor open space that is characterised by shade-giving vegetation.  See fig.21

9. Open spaces in and around public and private buildings are vitally important in warm-humid subtropical cities to enable the movement of air around buildings and through interior spaces. Verandahs, gardens and ‘outdoor rooms’ provide essential aspects of subtropical life. Spaces such as these, in, around and atop homes and buildings, are an integral part of the subtropical open space system.  See fig.22 opposite.
• The built form in growth centres and corridors in the subtropical city/region will often be multi-storeyed, with relatively high site cover. Innovative approaches to shared open space and private open space are essential at both ground and upper levels.  See fig.23
• Well-designed communal open space, taking into account privacy and territoriality enables informal interactions amongst residents and both unplanned and planned activities. Smaller spaces, compartmentalised by use of vegetation are more successful than wide open expanses. Climate-responsive design underpins the success of these spaces.  See fig.24
• Design outdoor spaces such as balconies, decks or verandahs to be private yet connected to the outdoors and outdoor world. ‘Eyes on the street’ or to the courtyard make a lively and safe outdoor life.
• Design layered façades to provide rich transitions from outdoor to indoor space.  See fig.25
• Provide sheltered outdoor spaces between street and building entry. This provides cooling paths for air entering the building as well as much-needed protection from rain during downpours.

fig.24
The courtyard in a perimeter block residential development is designed as a series of ‘outdoor’ rooms. The swimming pool does not dominate the space.
Ease the everyday movement of pedestrian and cyclists by providing multiple pathways which are aligned to major pedestrian nodes and corridors.

Cyclists and joggers choose the footpath to avoid traffic, creating dangerous conditions for pedestrians.

As subtropical communities grow, so too must their inhabitants’ quality of life, through proximity and access to significant outdoor open space.
“People need green open places to go; when they are close they use them. But if the greens are more than three minutes away, the distance overwhelms the need.” Christopher Alexander et al. (1977)

Accessible open space, welcoming to all members of the community, is vitally important in the sustainable subtropical urban environment. People’s ongoing engagement with outdoor open space strengthens the role of place-identity as a driver for sustainable settlements. In the process of urbanisation, access to open space is under continual pressure. As the urban periphery extends further away from the urban centre, the open spaces of rural areas are less readily accessible physically or visually. As existing urban areas become more densely built and populated, open space is often absorbed by new buildings and infrastructure.

Access to the urban open space network should be a primary consideration for planning and development of denser urban centres and urban corridors. People will much more likely embrace increased density in the subtropical urban environment if it is supported by easy and appropriate access to passive and active recreational resources in open space.

Making open space more accessible relies on both the physical form of the space and the structure of the open space network.

Strategies
1. Accompany increasing levels of density with increasing proximity to significant open space. See fig.1
2. Ensure easy access to multifunctional open spaces for all members of the community. Consider the needs of people with a disability, the elderly and those who rely on walking and public transport. See figures 2 and 3
3. Prioritise desirable climatic conditions for urban open spaces and pedestrian pathways including shelter from wind, rain, and summer sun, and access to winter sunshine. Use arcades, overhead shelter awnings and substantial shade trees. Where possible, the main pedestrian movement routes between important places like homes and major open spaces should run on a north-to-south alignment. See INTEGRATE WITH NATURE (Principle 5) and USE VEGETATION (Principle 7). See figures 4, 5 and 6
4. Provide convenient pedestrian and public transport access from residential centres to use-intensive public open spaces including parkland, civic squares, and retail precincts. Reduce restrictions to pedestrian and bicycle access, and improve distances between crossings for navigation through busy streets.
5. Impermeability in the pedestrian movement network leads to frustration and impedes uptake of public or active transport. Avoid creating barriers which force people into detours which are particularly arduous in humid conditions. Take into account direct paths of travel for pedestrians. People prefer to walk the shortest route and will cut corners or cross roads unsafely if crossings are non-existent or spaced too far apart. See figures 7, 8, 9 and 10 opposite.
   • Ease the everyday movement of pedestrians and cyclists by providing multiple pathways which are aligned to major pedestrian nodes and corridors. See fig.11 opposite.
   • Provide multiple connections between and through public open spaces within 400 metres of transit stops to enhance daily flow of pedestrians and cyclists. See fig.12 overleaf.
6. In the network of open spaces, parks form key elements of the journey through the subtropical neighbourhood. See RESPECT TOPOGRAPHY (Principle 2) and INTEGRATE WITH NATURE (Principle 5). See fig.13 overleaf.
7. The street network reinforces the location of parks and green spaces. Streets run along the edges of parks, benefiting from perimeter shade trees, or streets provide vistas towards parks. See fig.14 overleaf.
8. Ensure active connectivity takes priority over vehicular transport through open urban space. When publicly owned urban open spaces such as parks provide sites for major infrastructure projects, such interventions may constrain rather than enable connections by restricting access or forcing pedestrians and cyclists to take long detours. Ensure that existing
INCORPORATE ACCESS TO OPEN SPACE

Parks are key elements in the network of open spaces in the transit-oriented neighbourhood.

Multiple pathways within 400m of transit stops.

Parks are key elements in the network of open spaces in the transit-oriented neighbourhood.
9. Make sure that small accessible open places are provided within three to five minutes walk in all living and working neighbourhoods.

10. Visual access to open space gives people a sense of proximity to open spaces and connection to the local and regional environment.
- Views to significant regional open space such as mountain ranges are important for the community’s amenity and place-identity values. See RESPECT TOPOGRAPHY (Principle 2)
- Views to open space support connection; visual access to open space is an invitation to participate in the potential or actual activities possible there. See figures 15, 16 and 17
- Avoid opaque ‘noise barriers’ to rail and road corridors as they become visual as well as physical barriers to community connectivity.

11. Ensure that urban open spaces are accessible both during the day and at night and are designed to maximise safe usage at all times.
Drawn to water. Connection with nature is the starting point for responsible environmental behaviour around water, a life-giving natural resource.

Use ground cover instead of water-consuming lawns.
Water is essential to the health and sustainability of the subtropical environment and its inhabitants. Water plays an intrinsic role in the character and identity of the subtropical humid urban settlement; its presence benefits both the macroclimate of the region and the microclimate of places within it.

People gravitate to water whether it is a large waterway or a paddling pool. Access to water enhances environmental and visual values of urban areas and is one of the SEQ region’s great lifestyle attractions. Ocean beaches, lakes and river banks are irreplaceable as ecosystems and recreational places.

Natural waterways within the urban area are highly desirable and their maintenance is extremely high priority. The SEQ Healthy Waterways Partnership comprehensive guide, ‘Water by Design, 2009’, describes how collaborative urban design, planning and engineering is the key to sustainable management of urban water, protection of natural water resources, and public access to waterways.

Subtropical urban design principles are complemented by water-sensitive design principles and both require deliberate attention at the earliest stage of the urban planning process.

### Strategies

1. Minimise the negative impacts of urban development on water quality and quantity. Water quality is affected by many types of pollution that is borne by water filtering into aquifers and flowing into streams, rivers and the sea. Urban development affects water quantity in two ways – by the demands of dwellings and industry; and by the volume of stormwater generated by rainfall and the extent of impervious surfaces (such as roads, roofs and walls). ‘Water by Design, 2009’ lists the following opportunities identified by Engineers Australia:

   - Detaining, rather than rapidly conveying, stormwater
   - Capturing and using rainwater and stormwater and alternative water sources to conserve potable water
   - Using vegetation to filter water
   - Water-efficient landscaping
   - Protecting water-related environmental, recreational and cultural values
   - Harvesting localised water for various uses
   - Localising wastewater treatment systems.

   Therefore, ensure the impact of environmental flows such as flood, drought, more frequent deluges, and tidal inundation is accounted for in decisions about what, where, how and why to build sustainable subtropical urban settlements of any kind. See fig.3

   Give priority to the efficiency gains to be made from managing water better, both at the planning stage of developments and for subsequent in-use operations.

2. Design for water. Celebrate the importance of clean water to the functioning of the lush subtropical environment by adopting water-sensitive urban design strategies to replenish and recharge aquifers and support existing and newly planned vegetation.

   - Acknowledge the presence of water in urban and suburban settings by retaining urban waterways when new urban development is planned. Integrate water movement and treatment systems within public areas.
   - Retain natural on-site water and flow paths as an intrinsic part of the development process and outcome. See fig.5 opposite.
   - Rehabilitate degraded creeks and floodways. Re-establish natural processes and local plantings to protect animal and plant biodiversity. Link ecological corridors to the open space network. See ENSURE OPEN SPACE DIVERSITY (Principle 8) See fig.6 opposite.
   - Design roads, public walkways and cycling paths to take advantage of rainfall and stormwater management through integrated tree planting and porous surfaces. See fig.7 opposite
   - Use water in urban design to contribute to local food production and harvesting urban agriculture, community gardens, edible landscapes, and aquaculture. See fig.8 opposite
   - Use ground cover plants instead of water-consuming lawn grasses. See figures 9 and 10 opposite.
• Where practicable, use ground cover planting or porous surfaces instead of hard paving. 
   See figures 11 and 12

3. Maximise the positive benefits of access to water in the subtropical urban environment.
• Waterways and the water’s edge are integral elements in the subtropical open space network. See INCORPORATE ACCESS TO OPEN SPACE (Principle 8) See fig.13
• Preserve public contact with water and natural waterways. Keep water within reach of people by reserving land immediately along the water’s edge for common use for a broad spectrum of recreational facilities. See figures 14 and 15
• Improve urban connectivity by locating walking and cycling routes in waterway corridors. Ensure that these paths incorporate waterway crossings and are in proximity to residences and recreational facilities. Apply crime prevention through environmental design (CPTED) safety principles of good visibility and casual surveillance. See INCORPORATE ACCESS TO OPEN SPACE (Principle 9) See figures 16, 17 and 18

4. Reflect the importance of water as a significant feature of subtropical places.
• Roof guttering, downpipes, and rainwater tanks are overt features of rain water management in subtropical buildings. Well integrated and considered, these features contribute to local distinctiveness. See CONSIDER LOCAL CHARACTER AND DESIGN (Principle 4) See figures 19 and 20 opposite.
• Ensure design for water harvesting and storage is resilient and responds to water availability and expected rainfall patterns. Resilient systems need to respond to prolonged dry weather or heavy downpours. These types of extreme weather events are predicted to occur more frequently as global climate changes. See figures 21–24 opposite.
• Fountains and other installations that celebrate water in public places are an important means of engaging people with water’s sensory qualities. The cooling effect of water on a hot day and the sound of water masking less appealing urban noises are welcome in urban environments. Waterscapes as public art can perform multiple roles and functions: 
  ~ encouraging human contact with water in a passive way 
  ~ attracting engagement through active water play 
  ~ communicating the resource value of urban water and assisting understanding of the water cycle. See figures 25, 26 and 27 opposite.
There is a clear relationship between the presence of significant trees and memorable outdoor centres. Shady, comfortable, walkable, vibrant, successful places have an authentic sense of place because they respond to climate and lifestyle.
Networks of mixed-use, transit-oriented and walkable centres will characterise well-designed subtropical cities of the future. As populations grow, new housing and workplaces focussed around public transport stations and business and industry hubs will lead the transformation from outwardly expanding, sprawling car-dependent suburbs to sustainable urban places.

Subtropical centres will range in scale, and in the primary services and facilities they offer, as well as intensity of use. Urban villages will range from major activity centres with a large residential catchment and a sustainable mix of homes, jobs, entertainment and social infrastructure, to neighbourhood centres characterised by homes and local shopping.

Rather than being internalised and car based, they will be outdoor oriented, with everything in comfortable walking distance, in response to the region's benign climate. Their open spaces and subtropical landscapes will evoke a sense of openness and connection to place.

**Strategies**

1. Successful outdoor centres are created through application of all of the principles described in this handbook. Refer specifically to **DIVERSIFY THE BUILT ENVIRONMENT** (Principle 3) to guide built form arrangement. Refer to **INTEGRATE WITH NATURE** (Principle 5) to optimise solar access, passive heating during winter and availability of cooling breezes in summer. See fig.1

2. Integrate centres into the network of open space and prioritise provision of local high quality public open spaces:
   - Public plazas and squares See fig.2
   - Neighbourhood and pocket parks
   - Recreational areas
   - Semi-private open space within a subtropical urban block.

3. Walking and integrated transport strategies contribute to positive development of outdoor interactions. It has been shown throughout the world that when pedestrians are given priority over fast-moving traffic, everyday activities grow in scope and number. See fig.3
   - Envision the transformation from car-dominated centres into street systems which favour pedestrian movement over motor vehicles. Design avenues or clusters of substantial trees in streets to slow traffic and shade pavements. See figures 4 and 5

4. Link centres into the network of pedestrian and cycling pathways. Promote urban walkability by connecting centres with their surrounding neighbourhoods. Ensure routes to centres are integrated into the local street network, and, where possible, establish a network of subtropical journeys independent of the car-dominated street network. See **USE VEGETATION** (Principle 7)
   - Ensure residential and commercial buildings are located within a walking distance of approximately 400m to the centre and its shopping streets, parks and public transport stations. See **RESPECT TOPOGRAPHY** (Principle 2) See fig. 6, and 7 opposite.

5. Design the main thoroughfares in centres to be active and multifunctional places.
   - Revive the traditional role of shopping streets and marketplaces as areas for informal gatherings and create a diverse series of gathering and seating spaces along the street. See fig.8 opposite.
   - Design the subtropical shopping street to enable a non-restrictive indoor-outdoor flow between the street environment and retail premises at ground level. See fig.9 opposite.
   - Orient subtropical shopping streets east-west where possible. Extend awnings over footpaths to provide protection from the sun and rain. See **DIVERSIFY THE BUILT ENVIRONMENT** (Principle 3)
   - Develop public transport, casual parking, bikeways, public squares and shopping cul-de-sacs on wider east-west running streets. Line the edges with awnings or arcades. See **INTEGRATE WITH NATURE** (Principle 5)
   - Consider rear lane access for service vehicles to free up space on street frontages for continuous pedestrian footpaths and for street planting.
   - Provide street planting on a scale that will develop a canopy above the shopping windows and awnings, keeping shopfront signage and displays visible and accessible. See figures 10 and 11 opposite.
Centres should encourage an active public realm, day and night. Evening activities outdoors are an underexploited aspect of the SEQ lifestyle. Promote street-oriented culture for outdoor evening activities, such as dining and strolling. See DEVELOP OUTDOOR MEETING PLACES (Principle 12)
Pleasant year-round climatic characteristics in SEQ support outdoor activities which engender informal interactions amongst people and contribute to a sense of community.
Meeting and socialising in the outdoors is a positive feature of urban living, well supported by the subtropical climate. Vibrant and well-located spaces for informal interaction amongst people contribute to the quality of life in public space. Without useable gathering places people can lose their sense of community and feel isolated even in a densely populated environment. See ACKNOWLEDGE INFORMALITY (Principle 6)

Growing densification of the urban environment increases the importance of places for being outdoors. In contemporary urban settings and buildings, an approach to design that allows for unimpeded movement between outdoor and indoor spaces complements our informal lifestyle and provides a number of benefits.

Urban elements such as semi-private and private courtyards, atria, communal open spaces within mixed-use and residential developments, shopping streets, and urban squares provide ideal opportunities for developing outdoor meeting places which are physically linked to the indoor spaces of subtropical buildings.

**Strategies**

1. Outdoor meeting places in subtropical centres and neighbourhoods include the following fundamental elements:
   - Shade, especially around the edges. See fig.1
   - Air movement and passive cooling. See fig.2 opposite.
   - Significant vegetation. See fig.3
   - Appropriate lighting, day and night
   - Places to sit. See fig.4
   - Views to nearby spaces and activities. See fig.5
   - Active edges which make it natural for people to pause and get involved. See fig.6

2. Ensure the scale of the outdoor meeting place is appropriate to its intended use, location and function to maximise comfort and usability. Over-scaled places may feel deserted and empty.

3. Design informal outdoor meeting places to be incorporated into residential areas. Create shaded outdoor kitchens for cooking and eating areas in local parks. Cooking outside prevents overheating of homes, and encourages social interaction. See fig.7 opposite.

4. In mixed-use and medium-density residential developments, use the principles of openness and permeability to design courtyards which are private yet not too enclosed, and which are a series of interconnected ‘outdoor rooms’. The size, orientation, heights and arrangement of the surrounding buildings, and landscaping are all important. See DIVERSIFY THE BUILT ENVIRONMENT (Principle 3) and ENSURE OPEN SPACE DIVERSITY (Principle 8)
PART FOUR
Glossary and Reference Material
arcade  a roofed passageway, often adjoined to shops on one or both sides; may be formed by a colonnade on a street frontage by setting back the line of enclosure at ground level

bioretention  In water treatment and stormwater management, bioretention is the process of removing contaminants or nutrients from water by passing it through a filter medium such as soil containing microbes and plants. Contaminants are retained while cleansed water flows through. Bioretention systems may typically be designed to treat polluted stormwater run-off from roadways and car parks, preventing such pollution from flowing into waterways.

boulevard  A thoroughfare designed for high vehicular capacity and moderate speed, traversing an urbanised area. Boulevards are usually equipped with 'slip lanes' to buffer footpaths and buildings from the main flow of traffic.

brownfield  A redevelopment area previously used primarily as an industrial site

carbon dioxide (CO₂)  A greenhouse gas produced as the carbon in burning fossil fuels, such as coal and oil, combines with oxygen from the air.

climate sensitive urban design  design which takes into consideration the climate variables which affect human comfort within a particular climatic zone in order to provide the most comfortable thermal environment

crime prevention through environmental design (CPTED)  refers to ways of designing the built environment, particularly public spaces, to lessen or prevent the incidence of crimes against people and property

colonnade  a structure composed of columns placed at regular intervals, usually supporting a roof

CO₂  see 'carbon dioxide'

comfort zone  The range and combination of temperature, humidity and air movement that result in environmental conditions which most people find comfortable. The subjective nature of comfort is accounted for by assuming that a certain minimum percentage of occupants (e.g. 70 per cent) find the conditions comfortable. Evaluation of comfort in a particular environment is usually based on the 'comfort votes' of many people.

CPTED  see 'crime prevention through environmental design'

courtyard  an open space surrounded and adjoined by buildings that may be created within a large building or in the middle of an urban block

cultural heritage  Relates to places or objects of aesthetic, architectural, historical, scientific, social or technological significance to the present generation or past or future generations. These cultural heritage values can be associated with both the physical features of a place and intangible qualities such as people's feelings for a place.

density  the number of dwelling units within a standard measure of land area (e.g. per hectare)

diurnal range  the range of air temperatures from minimum to maximum over a 24-hour period

drip-line  The surface area below a tree's canopy is a good indicator of its root zone. This should be kept free of impermeable material to allow water and nutrients into the soil around the roots.

energy-efficient design  design that combines a range of design principles, materials and devices that contribute to significant reduction in energy demand for active heating, cooling and lighting of buildings

environmental sustainability  the long-term maintenance of health and integrity of natural ecosystems for future generations

environmental value (EV)  relates to the particular values or uses of the environment which are important for a healthy ecosystem or for public benefit, welfare, safety or health

equinox  The equinox marks the midpoint of the sun's annual path between the winter and summer solstices — 21 March and 23 September mark the equinoxes. On these dates the length of the day between sunrise and sunset is 12 hours. The sun rises due east and sets due west on these days. From the March equinox to the September equinox, the sun rises north of east, and sets north of west. The winter solstice on 22 June is the year's 'shortest day'. After the September
equinox, the sun rises south of east, and sets south of west. The summer solstice on 22 December is the year’s ‘longest
day’. At noon on the equinoxes, the sun is due north and its angle of altitude can be calculated if the latitude of the location
is known. The angle of altitude at noon is equal to the complementary angle of the latitude, that is, 90° – x°. For example,
Brisbane’s latitude is 27.5 ° south, therefore the angle of the sun’s altitude at noon on the equinox is 62.5°.

greenhouse gas emissions A natural part of the atmosphere, they trap the sun’s warmth and maintain the earth’s
surface temperature at a level necessary to support life (thus the term, ‘greenhouse’). Water vapour, carbon dioxide,
methane and nitrous oxide are the most common greenhouse gases. Human activities are increasing the production and
release of these gases (except water vapour) into the atmosphere. These emissions are resulting in a greater concentra-
tion of greenhouse gases in the atmosphere, enhancing the greenhouse effect and contributing to global climate change.

greenfield an area that consists of open or wooded land or farmland that has not been previously developed for urban
uses

greenway an open-space corridor in largely natural conditions which may include trails for bicycles and pedestrians

greyfield a redevelopment area previously used primarily as a parking lot

good urban design Aims to achieve a high level of quality, comfort, safety, equity and aesthetic within the urban
environment through appropriate planning, engineering, architectural, landscape and urban design. It is also concerned with
local identity and sense of place, cultural responsiveness and environmental protection.

infill development A new development that occurs within an established urban area where the site or area is either
vacant or has previously been used for another urban purpose. The scale of development can range from the creation of
one additional residential lot to a major mixed-use redevelopment.

massive Materials (e.g. concrete or brick) that absorb heat slowly, store heat, then retransmit heat as the surrounding air
temperature falls. When used externally, the surface heats up and reflects heat, light (glare) and ultraviolet radiation. The
surface may become very hot, especially if it is dark in colour.

macroclimate the characteristic climate of a broad area

microclimate a zone where the climate of a specific place differs from that of the surrounding area due to localised
influences such as slope, exposure to winds or sun, elevation; or where elements in the built environment such as fences,
walls, buildings or vegetation influence air movement, shading and so on

open space any land or water in an urban environment, and the space and light above this land or water, that is not
covered by buildings or roadways

orientation the direction which the outer surface of a wall faces; the term may also refer to the direction which the main
side of a building faces

perimeter block An urban form that achieves high urban densities without tall buildings. Buildings of medium height
/about four to seven storeys), developed along the perimeter of an urban block form a defined edge to the street. Entrances
face the street, and buildings may surround a central semi-private open space such as a courtyard. Buildings may contain
a mixture of uses, with commercial or retail functions on the ground floor and residential uses on upper floors

plaza an outdoor space, usually formal and paved, which is designed for civic purposes and commercial activities and is
spatially defined by building frontages

public realm the publicly accessible space between buildings including streets, squares, forecourts, parks and open
spaces (also known as the ‘public domain’)

riparian on the fringes of and adjacent to water bodies

sequestration The capture and storage of CO₂ from the atmosphere. Trees absorb CO₂ and store it as wood fibre, or
cellulose. CO₂ remains bound (or sequestered) in the wood, even when it is converted into timber building materials.

site cover the ratio of the area of the site covered by buildings relative to the site area
**solar heat gain** the increase in the amount of heat in a space resulting from entry of direct sun to the space

**solar ultraviolet radiation (UVR)** An energy band of the solar spectrum. Unlike the sun's heat or light, UVR cannot be seen nor felt, yet exposure to UVR is a major contributing factor to the development of skin cancer. Queensland has the highest rate of skin cancer in the world.

**square** an outdoor open-space type designed for recreation and civic purposes, spatially defined by building frontages and often formally designed

**sub-region** Derives from a larger region and is usually based on location. For the purpose of this handbook, areas which are either coastal, hinterland, or inland have been considered as the sub-regions.

**sustainable urban design** development that provides high quality urban living, maintains the health of the natural environment, enhances a locally based economy and demonstrates no net loss of natural resources

**swales** Shallow, open, vegetated channels that contribute to stormwater drainage systems. They usually run along median strips or street verges, and may either complement or replace underground pipe systems. They contribute to water quality by removing some pollutants and to water conservation by irrigating associated trees and ground covers. For more information see 'Water by Design' (2009).

**thermal comfort** the range and combination of environmental conditions including air temperature, humidity, air movement and radiation which most people find to be pleasant (see also comfort zone)

**topography** major land surface features comprising hills, valleys and plains

**ultraviolet radiation (UVR)** see solar ultraviolet radiation

**urban area** An area comprising the territory and dwellings located in a continuously built-up area. Areas with a population of 50,000 or more with a central core are considered to be urbanised.

**urban block** The central element of planning and urban design. An urban block is the smallest land area that is surrounded by designated streets. The block may be subdivided into any number of lots or parcels of land.

**urban design** The design of particular spaces and urban elements. It often encompasses the preparation of design guidelines, regulatory frameworks and legislation to control development.

**urban footprint** urban areas and greenfield areas potentially suitable for future urban development

**urban heat island effect** The phenomenon that occurs when air temperature in urban areas is significantly hotter than the surrounding rural areas. Increased urban air temperatures are attributed to 'artificial heat' released into the urban atmosphere by combustive processes of vehicles, industrial activities, and commercial and domestic air-conditioning. Increased density of paved and reflective surfaces also contributes to heat retention in urbanised areas.

**values sensitive urban design** the responsiveness to values that centre on cultural heritage and identity of an urban area

**visual access (visibility)** the opportunity to see into an urban space before physically entering

**water-sensitive urban design** Holistic approach to the planning, design, construction and retrofitting of urban development that aims to minimise negative impacts on the natural water cycle and protect the health of aquatic ecosystems. It promotes the integration of stormwater, water supply and sewage management within a development precinct. ('Water by Design', 2009)


Brisbane City Council. 2006. Living in Brisbane 2026, Brisbane, Australia.


REFERENCES


The Centre for Subtropical Design

The Centre for Subtropical Design aims to ensure that growth and development in Brisbane and South East Queensland follows best practice design principles that support a strong and vital community with a unique sense of place, reflecting our subtropical environment, our heritage and our vision for the future.

The Centre for Subtropical Design in the Faculty of Built Environment and Engineering at Queensland University of Technology (QUT), was established in partnership with Brisbane City Council (BCC) and QUT in response to concerns that the pressures of rapid growth were having a negative impact on the identity of the city. Jointly funded by BCC, QUT and the Queensland Government Department of Infrastructure and Planning, the Centre works to research and to provide industry leaders and the broader community with solutions in the field of subtropical design.

Expertise in subtropical urban design is drawn from a wide range of disciplines, including architecture, interior design, landscape architecture, urban design, planning, surveying, construction management, humanities and environmental management.

The activities of the centre include:
- building knowledge about subtropical design through research
- conferences, community forums, workshops and seminars
- partnerships with industry, government agencies and other universities
- publications, education tools and courses.

International activities

Every two years, the Centre brings together experts from all over the world for an international conference. ‘Subtropical Cities 2008’, with the theme ‘From fault-lines to sight-lines Subtropical Urbanism in 2020’ was held in September, 2008. The conference proved to be an impressive example of sharing expertise and experience across disciplines as a basis for collaborative problem solving at an international level.

With the generous support of ‘mecu’, the Australian financial cooperative, the Centre has awarded a travel bursary each year from 2006 to 2010 to an industry professional to travel overseas to investigate initiatives in the field of subtropical design. These are subsequently shared with the community through a number of key presentations.
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I wish to thank those who contributed over an extended period to the successful publication of *Subtropical Design in South East Queensland: A Handbook for Planners, Developers and Decision Makers*. It achieves our goal to deliver a practical guide that explains and demonstrates how to implement the subtropical design principles outlined in the South East Queensland Regional Plan 2009-2031.

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Rosemary Kennedy
Director
Centre for Subtropical Design