PILBARA VERNACULAR HANDBOOK

PREPARED FOR LANDCORP
APRIL 2012

LANDCORP

Printed Aprill 2012

COVER ARTWORK: Artist: Jules Sher. Star Over Tracks and Salt Pans. Acrylic on board, 2007. jules-sher.com
Representative: Linton & Kay Fine Arts Galleries. http://www.lintonandkay.com.au

CONTENTS

EXECUTIVE SUMMARY

The Pilbara Planning and Infrastructure Framework (2011), states that "the Pilbara region has become the economic powerhouse of Australia and is now on the threshold of another period of significant expansion ... by 2035, the [Pilbara] region will have a residential population of some 140,000 persons." This is a significant increase from the 41,000 people living in the region recorded in the 2006 Census.

Such a large population surge is going to require major upgrades to the existing infrastructure and built environment of towns in the Pilbara. Consequently, the scale and character of the existing Pilbara town sites are going to require strategic direction for future urban and suburban development.

The launch of the Pilbara Cities Vision by the Western Australian Government in 2009 proposes a complete transformation of towns across the region in order to provide centres that will attract new residents from Australia and overseas.

Currently, much of the existing building fabric was developed as a rapid response to the demands for accommodation and infrastructure for the embryonic iron ore mining industries in the 1960s. At the time, it was expected that these buildings and infrastructure would have a 25 year lifespan. There was little respect for local circumstances, such as a design and building response to the harsh, arid climate or provision of social and cultural amenities for the new residents.

Future transformation requires an almost complete regeneration of the existing urban form and includes major restructuring and activation of town centres; densification and renewal of existing residential areas; development of new residential, commercial and industrial areas; as well as major upgrades and replacement of services and amenities infrastructure.

Furthermore, the public infrastructure required to meet the challenges and extremes of the Pilbara climate and geography are immense.

In our analysis, several constraints to the future development of Pilbara towns quickly became apparent, namely:

- *the lack of existing infrastructure capacity to meet the demands of projected growth*
- *the high cost of housing and construction generally,*
- *the inheritance of existing urban and built form which has evolved from short term, cost driven responses to the development of communities often resulting in poor quality, inappropriate buildings.*

Despite all of this, a regional vernacular has emerged in the analysis of buildings in the Pilbara towns. However, rather than evolving into a distinct architectural language, a Pilbara vernacular can be found in random building elements which respond to the unique and extreme climatic, landscape and environmental conditions.

Often, this response was unplanned and intuitive, with buildings constructed in haste and with materials that were immediately accessible or easily transportable over long distances. Sometimes, the result is neither aesthetically pleasing nor finely crafted, but nevertheless some lessons can be learned. Therefore, whilst responding to the local vernacular, it is imperative that we rethink how we design and build in the Pilbara to avoid the mistakes of the past and to deliver towns that foster the creation of communities.

Evidence of a town specific built form vernacular is found in Onslow and Port Hedland where original houses have climate responsive gestures and a choice of materials resulting from the isolated location.

Newman viewed from Radio Hill lookout

Port Hedland's earliest buildings were constructed in local stone and suggest an architectural vernacular which responded to the hot climate. The public buildings constructed in the 1960s attempted to respond to the harsh conditions with masonry and lightweight steel. Unfortunately, there are only a few examples of contemporary architecture in Port Hedland which demonstrate climate responsive design.

Within Port Hedland's residential realm, including the Pretty Pool and Cooke Point subdivisions, attempts have been made to establish a Pilbara-appropriate housing typology.

Houses in Port Hedland (including Pretty Pool and Cooke Point) typically possess wide verandahs and flexible living arrangements allowing for the different spaces within each home to be utilised throughout the year. High and low level shutters, deep eaves, window awnings, permeable fencing and balustrades allow for ventilation and shading.

Housing developments in South Hedland constructed by mining companies do not have a noticeable vernacular response apart from choice of lightweight materials. It is common to see houses with narrow eaves and no shading to external walls and openings.

Onslow is unique because it is one of the few places in the Pilbara not created by the mining industry. Here, the early houses feature obvious climate responsive architectural elements, including timber and stone construction. The subdivision development by Onslow Salt introduced the typical mining company approach to housing and doesn't respond to the town's intrinsic character. The only positive is that the

EXECUTIVE SUMMARY

development is situated on the top of a ridge and benefits directly from the cooling westerly sea breeze.

Newman reads most clearly as a purpose built mining town. Here, the majority of built form has developed as a response to the constraints of cost and access to construction materials. Very little concern has been paid to addressing climate issues, particularly for housing. A repetitive approach to residential planning has been applied to each subdivision within the township. Despite this, there has been considerable focus on the community and social aspects of the town and, as a result, Newman has a stronger community of permanent residents than other Pilbara towns.

Of all the Pilbara towns, Dampier has the most loyal and committed population. This can be largely attributed to its prime coastal location. Town planning in Dampier is exemplary and should be referenced in future subdivisions throughout the Pilbara. Techniques such as lot staggering, considered orientation and the integration of landscaping within the town all contribute significantly to livability in an extreme climate. Solar access is simply, but effectively, controlled and cooling is achieved by using the sea breezes. Clever design at a macro level ultimately contributes to more affordable building as there is less necessity for additional shade screening and reduced reliance on mechanical cooling systems.

In relation to the public realm, Dampier's town planning displays evidence of climate responsive consideration with a cardinal, staggered lot layout and Port Hedland's cardinal grid also aids simple shade and ventilation housing solutions.

The Pilbara Vernacular Handbook lays out a context for future development of the public realm, housing and built form in the Pilbara. Each of the Pilbara towns examined in this handbook are explored within a framework of key design values, principles and strategies. The key design values are:

- *Responding to climate*
- *Incorporating the natural landscape*
- *Building on the Pilbara character and identity*
- *Enhancing livability*
- *Mobilising for change*

The final value, Mobilising for Change, recognises that the preceding strategies cannot be embraced without a conscious effort to change the status quo. Mobilising for Change strategies suggest how that might occur.

Examples of a town specific built form vernacular are found in Onslow

Newman

Port Hedland

Dampier

INTRODUCTION

The Pilbara Vernacular Handbook is timely in that it has been prepared at the threshold of a new surge of growth in the Pilbara. In order to capitalise on the opportunities that this future growth offers, we need to rethink design responses to creating communities, and shift from short term to longer term regionally specific responses. The scale and character of the existing Pilbara towns are going to require strategic re-imagining for future urban and suburban development.

This handbook aims to set up a base from which to consider and explore how rigorous planning and design can make a positive difference to the Pilbara of the future. The objectives are to:

- ensure high quality buildings and public realm and enhance the interface between the two
- provide a contemporary design response to the Pilbara context including logistic and economic considerations
- evoke a sense of place which reflects the local landscape, environment, climate and culture.

The task of identifying a Pilbara vernacular for urban development and a built form is a unique and unprecedented challenge. The Pilbara has some places of historic significance from early settlement periods prior to post war mining booms. These buildings are characterised by heavy masonry construction and wide verandahs. Often the buildings and streets have been eroded by an extreme climate and recently introduced Western industrialisation.

Generally, there is little remnant built heritage to draw on, although we see glimpses of how early houses responded to the Pilbara conditions in the town of Onslow.

Contemporary built form is generally comprises lightweight metal construction, minimal shading and insulation and thus a proclivity of mechanical cooling devices. Many buildings have been built for a 20-30 year lifespan, and are now approaching the end of usable lifespans. Any new developments must respond innovatively to the climate, the place and the culture, and through this new built work a Pilbara vernacular can develop more clearly.

Although the Handbook focuses on four towns in four different Shires, the Pilbara vernacular strategies are in no way limited to these specific places. The four towns investigated are:

Newman, Shire of East Pilbara

Port Hedland and South Hedland, Town of Port Hedland

Dampier, Shire of Roebourne

Onslow, Shire of Ashburton.

A Vernacular Design Principles handbook has already been prepared for Karratha (LandCorp, 2011)

INTRODUCTION

HOW TO USE THIS HANDBOOK.

The content of the Pilbara Vernacular Handbook is constructed from a thorough analysis of the existing context of the Pilbara and the four focus towns. The contents are organised so that a reader who has a particular interest in one town should read the general Pilbara region part of the handbook and then the part specific to that town.

The information for the general Pilbara region and each town is identified as:

- Analysis
- Opportunities and Constraints
- Values
- Principles
- Design Strategies

To arrive at a comprehensive and relevant set of strategies which might inform a Pilbara style, this handbook looks at the assets and the shortcomings for the existing public realm and housing or buildings in the region and its towns. These are expressed as Opportunities and Constraints.

Five core values have been identified:

- Responding to climate
- Incorporating the natural landscape
- Building on the Pilbara character and identity
- Enhancing livability
- Mobilising for change

Values are beliefs and aspirations, they need tangible expression in the form of principles, or general rules which should be observed to attain them. The design strategies are a plan of action for each Principle which enable us to implement change for the urban future for the Pilbara and are applied to the public realm and housing.

This Handbook uses two main areas of outcome - the Public Realm of towns and their Built Form.

Public realm embraces aspects of public life, which affect residents in their daily activities, such as town planning, urban formations, parks and open space and streetscapes.

Housing and built form deals with design and building methodologies and systems appropriate to the region and towns. It is acknowledged that the vast bulk of built form that is required in the Pilbara will be single and group housing. This typology is discussed in some detail in Design Strategies, but much of the design intent is applicable at buildings of all scales.

The handbook also presents a range of case studies which are appropriate to the Pilbara context.

Studies and reports on conditions relevant to the Pilbara can be found in the Appendices.

A Glossary defines terms which are regularly found in this handbook and which are particularly relevant to the Pilbara context. The definitions are provided so the reader can understand the meaning of the term as intended in the handbook and should not be regarded as definitive.

Data has been sourced from various local, state and federal government documents, firsthand observation by the authors and discussion with local residents and workers. In particular, the Pilbara Planning and Infrastructure Framework (2011) commissioned by the Western Australian Planning Commission and the Department of Planning is a source of essential statistical information throughout this handbook.

A bibliography is provided for extended reading and reference to provide wider, more detailed information.

PILBARA VALUES

Responding to CLIMATE

Incorporating the NATURAL LANDSCAPE

Building on the PILBARA CHARACTER & IDENTITY

Enhancing LIVABILITY

Mobilising for CHANGE

As you progress through this handbook the core Pilbara Values underlying design principles and strategies for the region and individual towns are highlighted by a common colour to assist with cross-referencing and comparison.

INTRODUCTION

THE INTENT OF PREPARING A HANDBOOK

Unlike so many towns, cities and regions which have a distinctive built form, sometimes ancient, which defines a local design context and language, the Pilbara and its towns are at the threshold of developing a vibrant and distinctive Pilbara urban and built form language which clearly reflects the dynamic spirit of the place. These strategies will lay the foundations for the future urban realm and built form for the Pilbara. The handbook will also assist in creating a common focus for the people from many industry, commerce, government and community bodies who will contribute to the future of the Pilbara.

It is not the purpose of this handbook to make recommendations for the social, cultural and commercial future strategies for the Pilbara. We are conscious of the need for adaptability and flexibility in any urban design vernacular so that the parametres can allow for and accommodate the unexpected and extraordinary.

Each town must be allowed to grow as an individual community just as the Pilbara needs to evolve as an entity which reflects its context and not the imposition of an imported urban formula.

We can not anticipate or predict the future impact of the natural resources industries on life in the Pilbara. Whilst resource mining is the reason for the existence of many Pilbara towns and will continue to provide employment to a majority of residents, we assume a long-term outlook for resource mining which will support a long term urban design strategy for the region.

The strategies are not prescriptive and provide a guide for improving planning and future urban design and built form. The strategies work alongside the R-Codes and the BCA and do not override them in any way. The new R-Codes for housing above the 26th Parallel will be a welcome companion for this handbook.

WHO SHOULD USE THIS HANDBOOK

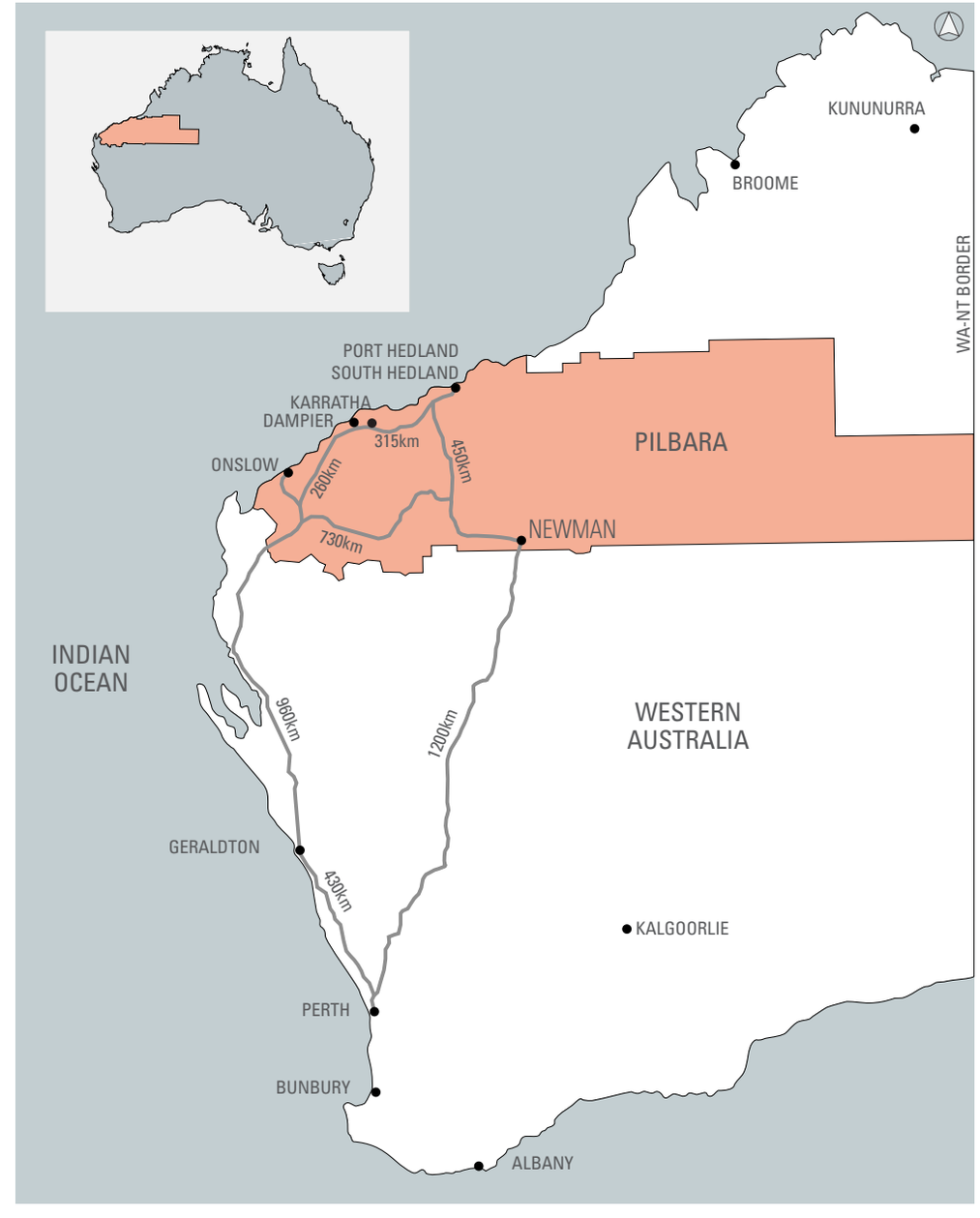
The Pilbara Vernacular Handbook has been commissioned by LandCorp, the Western Australian Government's land and property development agency.

Anyone who contributes to decision making which affects the urban realm, housing and built form in the Pilbara should read this handbook and use the Values, Principles and Strategies as a point of reference for future work.

LandCorp partners and consultants, architects, planners, designers, developers, project managers, builders, service and infrastructure providers, business operators and managers can all benefit from understanding the intent and applications of the Pilbara Vernacular Handbook. Whilst this is not a mandate for future development, this handbook opens up a dialogue of possibilities for the future development in the region.

PART 1

THE PILBARA REGION



PILBARA

OVERVIEW

The Pilbara region covers an area of 502,000 square kilometres in the north of Western Australia and includes the Shires of Ashburton, Roebourne, East Pilbara and the Town of Port Hedland. It extends from the Indian Ocean coast to the Northern Territory border. Perth is over 1,200 kilometres south.

The harsh physical climate and geography of the Pilbara create many challenges for planners and designers who must deal with high temperatures, a cyclone season and long spells of rainless days. The coastal towns are humid with a typical wet season from December to February. Inland, the towns can experience extreme high temperatures and dry conditions for extended periods.

In the second half of the twentieth century, the Western World brought a singular industrial and commercial might to facilitate the creation of towns in the Pilbara. This has occurred by responding to immediate needs rather than a planned, longer term vision for Pilbara communities. As a result, the supporting infrastructure is struggling now to service the ongoing growth of these towns.

The remote location further complicates the potential livability in the Pilbara towns. Living expenses are significantly higher than other Australian towns. This affects, in turn, social sustainability through lack of amenity and identity, particularly for the indigenous communities which are often found on the fringes of townships both literally and socially.

Environmental sustainability needs to be addressed now, prior to further growth, to ensure intelligent, integrated and sensitive expansion occurs. Economic, social and environmental sustainability are intrinsic to the future of the Pilbara.

THE PILBARA TOWNS

The small towns in the Pilbara region are unique because of their relative newness. They have a very short built form history. Whilst there was some early settlement to support local pastoral and mining activity, the settlements we see today have largely developed since the 1960s.

Isolation and distance has a huge impact on living in the Pilbara, both economically, socially and culturally.

Not only is the Pilbara region geographically isolated, but also the Pilbara towns are isolated from each other with vast distances between them. This means that the towns lack the interdependency which evolves when small towns are in close proximity. Future planning will require innovative solutions for self-sufficiency as well as technologies which connect the towns of the Pilbara to each other as well as the rest of the world.

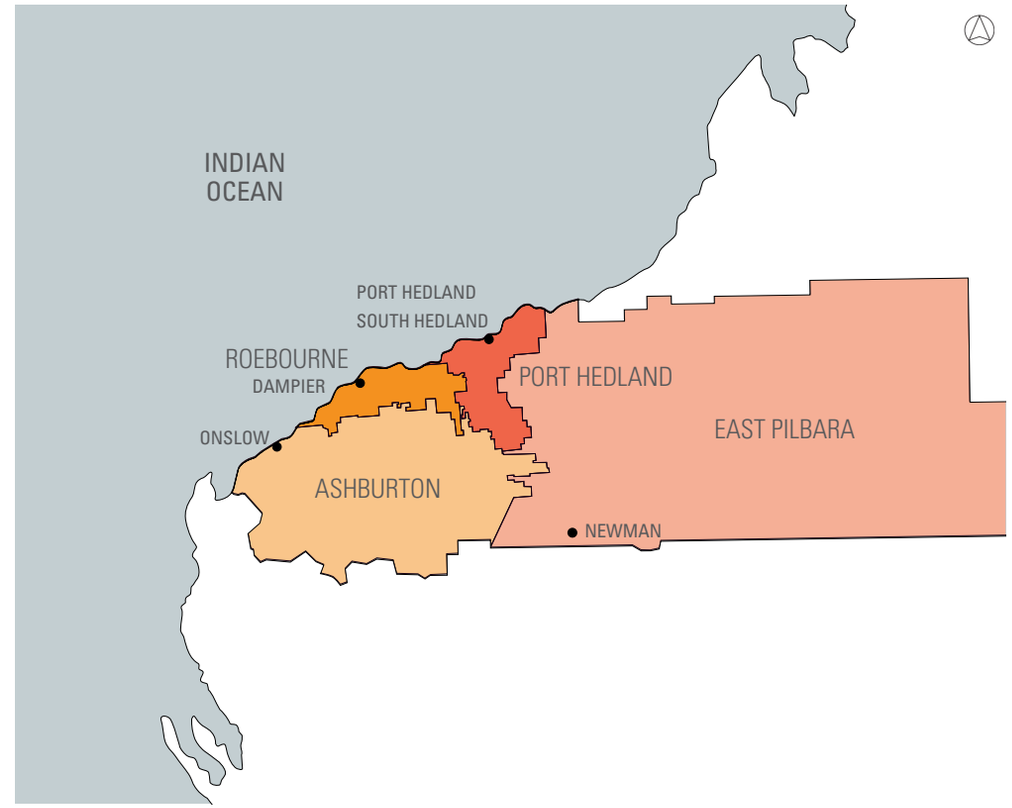
NORMALISATION

When mining companies moved into the Pilbara in the 1960s many of them built towns next to mine sites and had full control and responsibility over all aspects of town management, maintenance and development.

The towns were called “closed towns”. During the 1980s, a process of normalisation occurred, with state and local government authorities starting to assume responsibility for standard functions in each community.

The majority of civic and infrastructure functions in the towns were transferred to the relevant government entities during the 1980s. However, the transfer of accountability for assets and services to local government for some towns is still incomplete.

In some towns, home purchasing schemes were introduced and towns, such as Dampier, now have a high proportion of owner-occupiers. The state government and Shire of Roebourne continue to work with Pilbara Iron to resolve outstanding normalisation issues.[1]



Pilbara Shire Areas

URBAN CONTEXT

Each Pilbara settlement faces its own urban design challenges and opportunities, as dictated by its physical setting and previous urban planning. For example, the physical separation of Port Hedland from South Hedland will play a major role in the future development of the town. In Dampier, the transition from mining company ownership to Shire or private ownership (described as normalisation) needs to be carefully managed alongside planning for future development.

1 Pilbara Iron: Understanding the Pilbara Region and its Economy. A Baseline Socio-Economic Assessment, 2011

PILBARA

OVERVIEW

The Pilbara Planning and Infrastructure Framework (2011) identifies the following key design considerations for the future development of Pilbara towns:

- Creating well defined and cohesive settlements – setting and form
- Adopting water sensitive urban design practices
- Developing urban structures that are permeable and engender connectivity
- Developing a Pilbara design vernacular with local variations between towns
- Ensuring lot layout and building design is climate responsive.

The Pilbara Cities Vision, launched by the Western Australian Government in 2009, proposes a complete transformation of towns across the region in order to provide centres that will attract new residents from Australia and overseas.

Key to the success of this transformation is an almost complete regeneration of the existing urban form, much of which was designed to meet basic accommodation and infrastructure needs to support an embryonic mining industry in the 1960s and expected to have only a 25 year lifespan. There was little respect for local circumstances, such as a building response to the harsh, arid climate or provision of social and cultural amenities for the new residents.

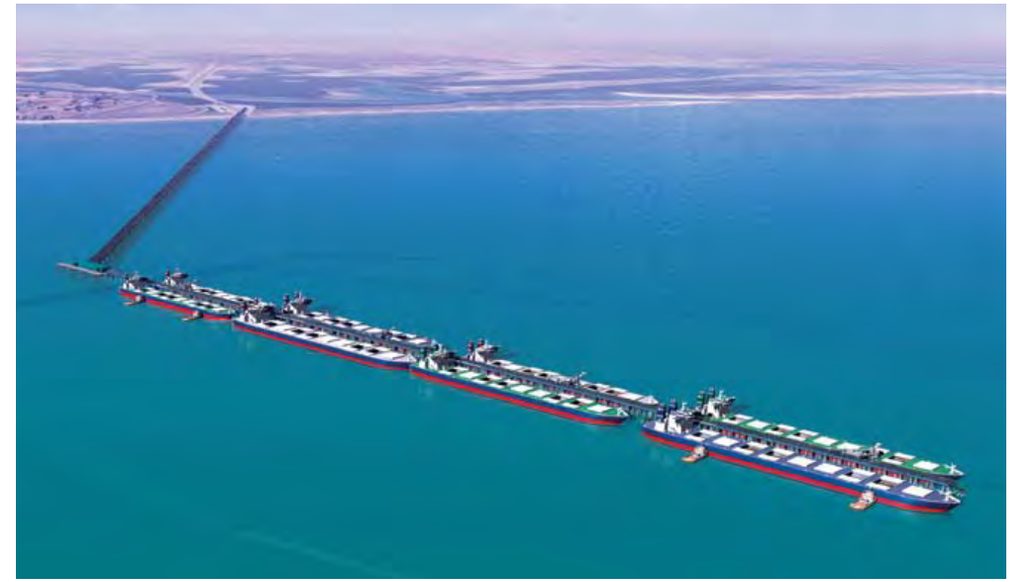
Future transformation includes major restructuring and activation of existing town centres; densification and renewal of existing residential areas; major upgrades and replacement of built environment, services and amenities infrastructure as well as development of new residential, commercial and industrial areas.

THE FUTURE OF THE PILBARA

The Pilbara Planning and Infrastructure and Framework further explains that "The Pilbara region has become the economic powerhouse of Australia and is now on the threshold of another period of significant expansion ... by 2035, the [Pilbara] region will have a residential population of some 140,000 persons". This is 100,000 more people in the region than recorded in the 2006 Census.

However, iron ore mining company, Pilbara Iron, cautions, "the ability of the Pilbara region to expand its economic base and population significantly in order to realise the government's vision for a thriving, sustainable and diversified regional economy has the potential to be compromised unless regional development planning addresses a series of challenges".2 It identifies lack of economic and industry diversity, resulting from over-reliance on the mining industry; lack of long-term population growth; high costs of infrastructure and services; a lack of clarity over towns service provision; and a marginalised indigenous community as impediments to future growth.

This handbook is a step towards ensuring an appropriately responsive public realm and built form to support successful future growth.



Artist's impression of the port facility expansion planned for Port Hedland

Future communities need support amenities so they can retain a long term permanent population

THE PILBARA ACCOUNTS FOR ALMOST TWO THIRDS OF WESTERN AUSTRALIA'S COMMODITY EXPORTS BY VALUE AND ALMOST 20% OF AUSTRALIA'S TOTAL VALUE OF MERCHANDISE EXPORTS.

2 Pilbara Iron: Understanding the Pilbara Region and its Economy. A Baseline Socio-Economic Assessment, 2011

PILBARA

ECONOMY

The value of Western Australia's petroleum and mineral industries reached a record $91.6 billion in 2010. Iron ore remained the State's most valuable resource in 2010 accounting for $48.5 billion or 53% of all mineral and petroleum sales.[1] The Pilbara contributes over half of this production to the State economy.

The dominance of the mineral and petroleum industries in the Pilbara has repercussions for the towns. There is an over-reliance on the mining companies for economic growth creating a one dimensional economy for the towns. China is the major market for resource exports and its future economic performance might significantly affect the Pilbara economy.

LIQUID PETROLEUM GAS (LPG)

All LNG from Western Australia originates from the North West Shelf joint venture project in Karratha which comprises five LNG production trains. Commissioned in September 2008, the 4.4 million tonne per annum fifth train is Australia's largest single LNG production unit and boosts the NWS's total annual capacity to 16.3 million tonnes.

Upcoming LPG projects will have a profound impact on the Pilbara towns. The huge financial value of these projects and the increase in population from the required workforce will double, sometimes triple, town populations over the next 25 years.

The first to begin production is Woodside's Pluto LNG Project, valued at $12 billion.

Chevron will develop the Gorgon project located off the northwest coast. The Greater Gorgon Area gas fields will be Australia's largest known gas resource. Over $20 billion in contracts have already been awarded for design, manufacture, delivery and commissioning and construction.

Chevron will also operate the massive Wheatstone project at Ashburton North, near Onslow, with a domestic gas plant.

IRON ORE

Rio Tinto Limited, together with its various joint venture partners and BHP Billiton (BHPB) dominate the industry in Western Australia and account for around 87% of the State's iron ore production.

Rio Tinto Limited is the largest iron ore producer in the Pilbara region. Its wholly-owned subsidiary Hamersley Iron Pty Ltd owns six mines, as well as several joint venture mines.

BHPB operates seven mine sites including one of the largest single-pit, open-cut ore mines in the world – the massive Mt Whaleback mine in Newman, which is five kilometres long and nearly 1.5 kilometres wide.

Fortescue Metals Group (FMG), with its Chichester Range, Cloud Break and Christmas Creek iron ore mines, is the third-largest mining company in the Pilbara. Shipments commenced in May 2008, transporting ore along their 260 kilometre multi-user railway to FMG's open-access Herb Elliott Port in Port Hedland.[2]

KEY ECONOMIC FACTS[3]

- The Pilbara provided approximately 75% of Western Australia's total merchandise export income in 2009 and 20% of Australia's total value of merchandise exports:
- This is produced by 0.2% of the national population[4]
- The Pilbara's resource production was $45 billion in 2009
- This represented approximately 14.5% of Australia's total merchandise exports in that year
- The value of the Pilbara's iron ore production was almost $32 billion in 2008-2009
- The value of the Pilbara's petroleum production was $16.8 billion in 2009
- The Pilbara has a significant output of copper (about 80% of the $1 billion annual industry) and gold (15% of the $4 billion industry)
- The Pilbara has the second largest solar salt fields in the world
- Other important exports are nickel, manganese, uranium, precious and semi-precious gems and construction materials
- There is a small manufacturing and service industry as well as tourism, pastoral and fishing industries.

The mining industry is omnipresent in the Pilbara. Newman Primary School sandpit

1 http://www.dmp.wa.gov.au/1525.aspx

2 Western Australian Mineral And Petroleum Statistics Digest 2009–10

1 Pilbara Planning and Infrastructure Framework, 2011, unless another source is stated
4 Department of Foreign Affairs and Trade Annual Report 2007–2008

PILBARA

DEMOGRAPHICS

The resident population in the Pilbara has grown from a few thousand in 1966 to approximately 41,000 in 2006. The Pilbara Cities Vision (2009) predicts the overall resident population of the region will grow to more than 140,000 by 2035, driven primarily by progressive expansion in the mining sector. This represents an average annual compound growth rate of around five percent. In response to this growth, the Pilbara towns will need to change in order to accommodate the people who will be part of the future growth.

Currently, Port Hedland and South Hedland, Karratha, Newman, Paraburdoo and Tom Price accommodate approximately 70% of the region's population. The remainder of the population is in smaller towns, remote pastoral and mining locations and Aboriginal communities.

The towns addressed in this handbook - Newman, Port Hedland, Dampier and Onslow - along with Karratha (which has a separate study) are expected to experience the most growth.

RESIDENT PROFILE

The Pilbara's housing density and form is likely to change significantly in line with future requirements. Larger towns can expect more residential apartments, townhouses and medium and higher density living.

Currently, fly-in fly-out workers (FIFO) provide a large proportion of labour requirements in the Pilbara. This is expected to continue and short-term accommodation needs to be aligned with longer term planning.

The indigenous population of the Pilbara is 5,632 or 13.7% of the total population for the region. This is a significantly higher proportion than Western Australia as a whole where indigenous people make up 2.3% of the total population.

POPULATION COMPARISON: OTHER REGIONAL TOWNS IN WA

There is currently no regional town in Western Australia that has a population in excess of 50,000 residents. Bunbury and its surrounding suburbs, such as Gelorup, make up a population of 50,000 residents. It is useful to consider the amenity and infrastructure in Bunbury as an indication of how we should expect the larger Pilbara towns to develop in the future.

Bunbury, Western Australia's third fastest growing regional city, has two major shopping centres, several large department stores, multiple shopping strips and a fast growing home-makers precinct. Bunbury's CBD is centred around the large ten story Bunbury Tower which sits among many other multi-story buildings housing office and residential tenancies. A $1 billion redevelopment plan for the city's foreshore has recently been unveiled which is to include multiple new buildings up to seven stories and a mix of residential dwellings and commercial spaces. Bunbury also offers many options for entertainment, arts, culture, food and tourism. Bunbury is home to an arts gallery that is the only 'A' class gallery south of Perth, an entertainment centre that provides theatre, film and live performances, a six-screen cinema and a large selection of bars, pubs, restaurants, cafes, clubs and other venues.

TOWN	POPULATION (2010)	POPULATION (2035)	% GROWTH
ALBANY	35,500	42,000	237%
BUNBURY (inc. Gelorup)	65,000	101,500	155%
GERALDTON	38,500	(by 2025) 68,000	175%
KALGOORLIE	32,400	not known	
NEWMAN	7,000	15,000	215%
PORT HEDLAND / SOUTH HEDLAND	15,000	50,000	330%
ONSLOW	700	6,500	925%
DAMPIER	1375	2,270	165%
KARRATHA AND DAMPIER	17,500	50,000	285%

Figures are broad estimates only. The influence on transient populations makes it difficult to accurately establish resident population figures

Sources: Western Australian Regional Cities Alliance. http://www.waregionalcities.com.au/regional-cities/kalgoorlie-boulder/ (accessed 8 September 2011). Pilbara Planning and Infrastructure Framework, 2011. Australian Bureau of Statistics

2035 POPULATION EXPECTATIONS BASED ON CURRENT PROJECTIONS

THE RESIDENT POPULATION OF NEWMAN, WILL INCREASE OVER 200%

THE COMBINED RESIDENT POPULATION OF PORT HEDLAND AND SOUTH HEDLAND WILL INCREASE OVER 300%

THE COMBINED RESIDENT POPULATION OF DAMPIER AND KARRATHA WILL INCREASE BY MORE THAN 200%

THE PROPOSED ASHBURTON NORTH STRATEGIC INDUSTRIAL AREA DEVELOPMENT COULD INCREASE THE RESIDENT POPULATION OF ONSLOW BY OVER 900%.

PILBARA

TOWN PLANNING

PLANNING HISTORY

The Pilbara town planning patterns reveal the time period when they were established. The first towns settled were based on the grid arrangement and towns and subdivsions established in and after the 1960s were based on more curvilinear shapes.

The influence of the Radburn model on planning in the 1960s within Australia was significant. Planners adopted its ideas and theories for a number of new suburbs in Canberra and Melbourne. In addition to local councils, state social housing providers, including Homeswest and the State Housing Commission, also became proponents of the model.

The key elements of the Radburn planning model are evident in South Hedland and in a limited form Dampier with the use of cul-de-sacs, curvilinear road layouts and extensive pedestrian-only linkages. Unlike their urban counterparts, the footpaths of these Pilbara based towns have been extended by the residents' desire to create shortcuts and more convenient pedestrian routes. These are used by both indigenous and non-indigenous residents. The Dampier town plan has key design strategies that future subdivision plans could utilise. These are outlined in the Dampier Town Planning Analysis.

Many of the Pilbara towns constructed during this time also share a similar built form expression. The majority of commercial and public buildings are individual buildings and of a domestic scale and construction method. Most are inward looking, turning their back on the harsh climate conditions, and fail to address the street.

PLANNING TODAY

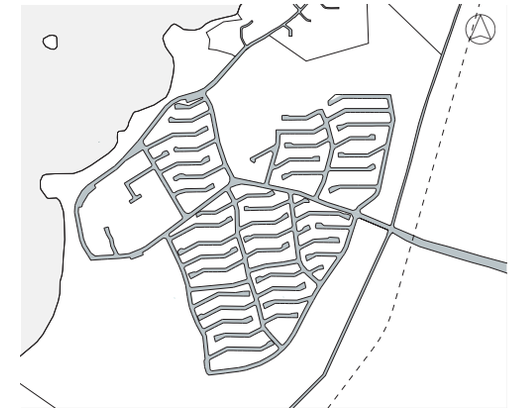
Currently, town revitalisation plans are either being implemented or being prepared. Generally the re-design of town centres needs to occur within the existing constraints of an established shopping centre and established commercial and retail operators.

The key aims for the town centres are to improve street permeability and building frontage activation as well as promote mixed-use medium density built form that addresses the need for both short stay and long term accommodation. The revitalisation plans for Newman, South Hedland and Karratha have been adopted and are currently in various stages of implementation. Onslow is currently working to address the town growth in anticipation of Wheatstone Natural Gas project. There is an opportunity to improve the commercial areas within the town, address the flood prone main street and consider zoning diversity to encourage higher density housing types. Dampier needs its normalisation process to be further advanced before any detailed planning review and concept designs can be formalised.

Old Onslow township plan, a typical grid arrangement

Communicating South Hedland's future plan

South Hedland town plan based on a Radburn planning model



Dampier town plan featuring cul-de-sac streets overlaid with pedestrian short-cut created by the residents

Newman town layout

Onslow town view

PILBARA

HOUSING

The 2003-2008 resources boom has had a dramatic state-wide effect on the economy, but none more significant than in the Pilbara. The Pilbara Planning and Infrastructure Framework identifies that, in the wake of the resources boom, a housing affordability crisis has occurred in the region.

A review by the Senate Select Committee on Housing Affordability in Australia (2008) has identified the main housing issues as:

- slow release of residential land (due to a variety of factors, including the time required to obtain Native Title and environmental clearances)
- high cost of developing residential land in the Pilbara's harsh environment
- shortage of builders, exacerbated by an inability to secure affordable housing in the region for their tradespeople
- resource companies being prepared to pay subsidies to workers and/or pay ever increasing prices to house their workforce
- shortage of public and Government Regional Officers' Housing (GROH) accommodation.

In particular, there is a severe shortage of housing opportunities for lower paid occupations, and people who do not have housing provided as part of their employment package, including people working for subcontractors and those working in the community, retail and hospitality sectors.

A study completed by the Department of Housing, in association with the Pilbara Development Commission estimates an existing latent demand for housing, of 3,878 dwellings across the region.

Town	Current Unmet Demands (dwellings)			Future Housing Demand 2009-2015 (dwellings)			
	Apparent Demand	Latent Demand	Total Unment Demand	Additional Future Demand: 2009-2015		Total Future Demand: 2009-2015	
				Low Growth	High Growth	Low Growth	High Growth
Karratha	613	918	1,531	560	1,125	2,091	2,656
Port Hedland	503	899	1,402	443	1,799	1,845	3,201
Newman	151	283	434	-45	580	389	1,014
Onslow	134	71	105	3	808	107	913
Tom Price	78	181	259	12	212	271	471
Roebourne	54	93	147	41	212	188	359
Total	1,433	2,445	3,878	1,014	4,736	4,892	8,614

Source: SGS draft Pilbara Housing Strategy: January 2010.
Dwellings: permanent dwellings.
Apparent Demand: includes housing waiting lists (social and GROH housing), homeless persons and overcrowding of current housing stock.
Latent Demand: undersupply of affordable and appropriate housing has constrained the regions' service and construction sectors, causing them to operate below capacity.

Pilbara Housing Demand: Current and Future

This shortage of housing is likely to continue with an estimated demand for a further 1,014 to 4,736 dwellings by 2015, based on low and high growth scenarios.

Residents should be able to choose a home that fulfills their requirements, be it for a family, shared singles, retirees, extended family or single parent family. Houses need to recognise the fly-in fly out and shift work patterns of Pilbara employment and provide facilities for people to share accommodation but still be independent.

Colorbond metal clad house typically found in Pilbara towns

This older house in Onslow uses awnings for simple, but effective shading and ventilation.

TO CATER FOR THE REGION'S POPULATION TARGETS AND SATISFY UNMET LATENT DEMAND, THERE WILL BE A NEED FOR AN ESTIMATED ADDITIONAL 40,900 PERMANENT DWELLINGS BY 2035. THIS WILL REQUIRE SOME 2,130 HECTARES OF NET RESIDENTIAL LAND.

PILBARA

HOUSING

EARLY SETTLEMENT UP TO WORLD WAR I

Characterised by lightweight framed workers cottages or substantial stone and masonry estates.

Lightweight with cyclone shutters, small two to four room footprint, pitched and gable ended roof, enclosed sleep outs and verandahs.

Heavy masonry with internalised rooms, small windows and doors, wide verandahs with stone or masonry columns to external verandahs.

INTERWAR PERIOD

Some activity, based around prospecting or fishing/pearling activity.

Larger rooms, on stumps, lightweight claddings, shutters, lattice work, galvanised cladding, gabled pitch roof, water collection via tanks, wrap around verandahs, kitchens come inside, washrooms and toilets still outside.

POST-WAR PERIOD

Largest sustained boom period for most of the Pilbara. Marked by exploration and mineral expansion of mines.

Large resource companies begin to construct housing for employees in towns next to mine sites. Some towns experiment with construction techniques, modular systems, prefabricated walling, etc. Cyclone ratings start to have an effect after Cyclone Tracey.

Housing is generally simple post war cottage: entry via hallway, double loaded planning, with wet services at rear. Often, there is a bathroom and laundry in lean-to or rear verandah.

The houses often had low ceilings, small rooms and inadequate shading, ventilation. Climate responsive techniques were not often included in the design of these houses but added later as the occupiers responded to strong sunlight, heat and hot winds. Today, we can see these houses with additions of screens, awnings, canopies and pergolas extending from the house and over driveways. These additions are also in response to living outdoors in hot weather and more recreational time to use patios and garden areas. Much of this building stock continues to be used today.

South Hedland's new living scheme looks to rejuvenate the suburbs of South Hedland.

Many of the innovative walling, roofing and construction systems, such as lightweight steel framing and fibro cladding, were a response to transport costs and shortages of skilled tradespeople. These systems are now deteriorating badly, without any mechanism for long term restoration, replacement or upgrades, apart from demolition.

The stud framed and brick veneer homes have been able to be upgraded, such as Newliving Department of Housing Program's recent project in South Hedland.

1980s

Often using Perth metropolitan planning systems, internalised corridors with multiple bedroom and bathrooms become commonplace. Open carports attached to dwelling for first time.

Larger lots allow for rear and side setbacks for planting, parking and other recreational uses.

1980s house in South Hedland which has been recently refurbished

CONTEMPORARY CONSTRUCTION

Characterised by lightweight pre fabricated roof truss and wall trusses in steel cold formed stud work. Cladding and roofing in Colorbond custom orb, no gutters, 900 millimetre eaves wherever mandated, open carports, large alfresco areas, hardstand and reduced lot sizes have constrained the ability to ventilate and enjoy outdoor spaces.

The carport is used for front of house recreation, sitting and surveillance of the street.

Mass air conditioning has been introduced into private housing and has meant that houses are closed up and effectively isolated from the natural environment.

Contemporary South Hedland house with wide covered carport used for recreation and outdoor entertaining

PILBARA

COMMUNITY INFRASTRUCTURE

The growth in the Pilbara as a result of the resources boom has placed huge demands on services and facilities which provide the basic needs for the local communities. Much of the infrastructure in the Pilbara is operating at full capacity and struggles to provide for the currently population. Anticipated growth will require major upgrades or additional new infrastructure.

Fundamental to the healthy growth of any community is a support structure of services and facilities which enhance the quality of living in that community. To attract and retain workers and their families to live in the Pilbara, towns will need to be able to offer adequate civic facilities, such as libraries, community centres and senior citizen centres and community support services as well cultural, recreation and entertainment facilities.

HEALTH

The Pilbara's hospital facilities are located in the region's main urban centres. However, there are significant service gaps, reflecting difficulties in recruitment, cost-of-living, housing and wages. To be effective, health services need to be carefully located to match settlement growth patterns.

A partnership between the State Government and major industries in the Pilbara will see an additional $38.2 million provided over five years to fund a range of healthcare initiatives targeting issues of access, infrastructure, response, service provision, sustainability and workforce. Funding will be allocated for remote Aboriginal Health Clinics across the Pilbara, as well as general practitioner, dental and other health specialist services.

Future needs relate directly to the expected expansion of economic activity. The realisation of the Pilbara Cities Vision will bring greater numbers and a concentration of people to the Pilbara which will place increasing demands on existing health infrastructure and services.

Whilst improving health infrastructure will be a priority, there will be ongoing and increasing demand for other support services including:

- greater use and investment in information technology to help provide telehealth services to overcome distance and human resource shortages
- careful planning to locate health services to match settlement patterns in the Pilbara
- building the capacity of Aboriginal health services
- increasing the provision of and collaboration with private health care providers
- adequate supply of quality housing to attract and retain health staff and visiting specialists.[1]

1 Pilbara Planning and Infrastructure Framework, 2011

Service Hub	Current Hub Service Population	Future Hub Resident Population	Current Facility Upgrades	Future Facility Upgrades
Port Hedland	19 000	50 000	New Regional Hospital	Expand Regional Hospital
Nickol Bay	18 700	50 000	Upgraded District Hospital	New District/Regional Hospital
Newman	6 000	15 000	Minimum Change	Upgrade District Hospital
Tom Price	2 720	3 000	Minimum Change	Upgrade District Hospital
Onslow	570	2 500	Minimum Change	New District Hospital

Future Hospital Needs. Note: Nickol Bay includes: Karratha, Dampier, Roebourne, Wickham, Point Samson and Cossack

The new Hedland Health Campus Hospital opened in November 2010 and is the new health care hub for the region (above and below)

PORT HEDLAND WILL NEED TO EXPAND ITS REGIONAL HOSPITAL. NEWMAN WILL NEED TO UPGRADE ITS EXISTING DISTRICT HOSPITAL AND ONSLOW WILL REQUIRE A NEW DISTRICT HOSPITAL TO SERVICE GROWTH ESTIMATES.

PILBARA

COMMUNITY INFRASTRUCTURE

EDUCATION

The Pilbara currently has 39 schools attended by more than 9,000 students and 600 staff. This includes a camp school in Dampier and a School of the Air in Port Hedland. There is one TAFE college (Pilbara TAFE) with a main campus in Karratha and a number of satellite campuses throughout the region.

The Pilbara student population profile shows a general growth in primary school enrolments but a decline in secondary school enrolments.

The retention of high school-age students is a significant issue for the region because of remoteness and low threshold numbers to sustain appropriate high school facilities and curricula. As a consequence, education in Perth and other southern towns is considered by many parents to be a superior option.

As with other services, staffing and associated housing is a major constraint in the delivery of education services in the region. There is a need to include residences for teaching and support staff, as well as students, in education precincts.

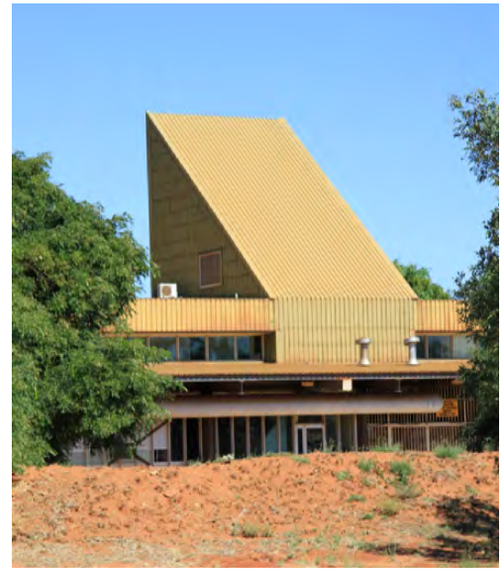
The Department of Education has well-structured criteria to inform decision-making about building new schools or expanding existing facilities. It is anticipated that facilities, in the short to medium term, will generally be met by augmenting existing facilities with demountable classrooms and associated structures. In the longer term, there will need a significant number of new schools, particularly in Karratha, Port Hedland and Newman.

Settlement	Primary School		Senior High School		District High School		TAFE Campuses	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Karratha-Dampier	6	15	2	4	-	-	1	1
Port Hedland	5	15	1	4	-	-	2	2
Newman	2	4	1	1	-	-	1	1
Tom Price	2	2	1	1	-	-	1	1
Onslow	-	-	-	-	1	1	1	1
Wickham	1	1	-	1	-	-	-	-
Paraburdoo	1	1	-	-	-	-	1	1
Roeburne	-	-	-	-	1	1	1	1
Pannawonica	-	-	-	-	1	-	1	-
Point Samson	-	-	-	-	-	-	-	-
Marble Bar	-	-	-	-	1	1	-	-
Nullagine	-	-	-	-	1	1	-	-
Total	17	38	5	11	5	4	9	8

Note: Does not include remote and independent community schools

Source: Department of Planning Regional Planning and Strategy. 2010.

Education Facilities: Existing and Anticipated Facilities. Source: Department of Planning Regional Planning and Strategy 2010



Port Hedland TAFE Campus

Onlsow Primary School

IN THE LONGER TERM, THERE WILL BE A NEED FOR A SIGNIFICANT NUMBER OF NEW SCHOOLS, PARTICULARLY IN KARRATHA, PORT HEDLAND AND NEWMAN.

PILBARA

COMMUNITY INFRASTRUCTURE

Settlement	Indoor Sports Complex	Fully Lit Ovals	Swimming Pools		Marine Facilities	
			50 m	25 m	Boat Harbour	Boat Ramp
Karratha-Dampier	1	5	1	-	1	12
Port Hedland	1	3	2	-	1	4
Newman	1	2	1	-	-	-
Tom Price	1	1	1	-	-	-
Onslow	1	1	-	-	1	3
Wickham-Cossack	-	1	-	1	1	2
Paraburdoo	-	1	1	-	-	-
Roeburne	-	1	-	1	-	-
Pannawonica	-	1	-	1	-	-
Point Samson	-	-	-	-	1	2
Marble Bar	-	1	-	1	-	-
Nullagine	-	-	-	-	-	-
Rural Pilbara	-	-	-	-	-	5
Total	5	17	6	4	5	28

Major recreation facilities. Note: Karratha-Dampier includes Burrup Peninsula

RECREATION

The climate has a huge influence on the recreational activities in the Pilbara. It is not surprising that outdoor activities, particularly boating, fishing, diving and swimming, are popular leisure and entertainment for coastal residents. The Pilbara has amongst the highest recreational boat ownership in Australia. Inland, motocross bike riding is popular. There are also active and well supported football clubs in many of the towns and each town has a sports field complex. The larger towns have public swimming pools.

There is already acknowledgement that more facilities are required to meet future recreational needs.

Proposed new sporting facilities include:

- two new marinas at Dampier and Port Hedland
- upgrades to boat harbours and boat launching facilities
- improved access to beaches
- upgrades to the region's swimming pools
- provision of more fully equipped sports ovals
- indoor recreation centres.

There is a need for lighting in sports grounds because it is more comfortable to play active sport in the cooler evening temperatures than in the heat of the day.

"The Beach" indoor play centre in Newman

The community garden in Onslow is a credit to the local residents who contribute to its upkeep

CULTURE AND ENTERTAINMENT

There are limited cultural and entertainment facilities in the region which is most likely explained by the short term, short stay pattern of life in the Pilbara. Critical to creating vital communities is providing a choice of activities which will encourage residents to stay and feel that they are not missing out on the services and facilities available elsewhere. This includes community and commercial places such as restaurants, cafes, nightclubs, bars, theatres, cinemas, art galleries and museums, spaces for clubs and non-government organisations. This will be particularly important in Karratha and Port Hedland as the main regional centres.

Fishing along Dampier beach

PILBARA

COMMUNITY INFRASTRUCTURE

COMMUNITY SAFETY

The Pilbara's law enforcement services are managed from the Karratha-based Pilbara District Police Complex. This recently completed facility includes a courthouse and juvenile justice centre. There are 15 police stations and eight courthouses in the region. A community legal service has offices in several towns. However, there is opportunity for private legal practices to establish offices to service the growing population.

CHILD CARE

Availability of childcare is an important factor in attracting and retaining skilled workers in the region. Government and industry recognise this and investment in childcare has meant that the current facilities are adequate. However, the location and type of services will need to be carefully monitored and planned to ensure that they can meet future demand and are appropriate for the working patterns of local residents, such as catering for long shifts and different shift hours.

As with other infrastructure services, staffing and associated affordable housing for trained staff are major constraints on the delivery of childcare and family care services in the Pilbara.

RETAIL FACILITIES

Retail facilities make an important contribution to the vitality of town centres. Increasing population will sustain more retail facilities which will provide more choice and a wider range of goods, particularly in Karratha and Port Hedland. Retailers will need to be assured of the viability of retail locations and an on-going customer base.

Revitalisation strategies for town centres, such as that underway in Newman, will help attract retailers and make the local shopping experience more satisfying. Retailers will also be able to benefit from revitalisation which encourages co-location of community and commercial services and facilities within a clearly identified centre.

South Hedland Shopping Centre

Newman Shopping Centre

Dampier Shopping Centre

Onslow Supermarket and Bottle Shop

Baynton West New Family Centre (due for completion November 2011)

Newman Police Station

PILBARA

UTILITY INFRASTRUCTURE

Many of the utilities supplying the Pilbara are already operating at capacity. Major upgrades or new infrastructure is required for the forecast population. Fundamental to future development in the Pilbara is strategic planning of infrastructure to ensure that it can service demand.

WATER SUPPLY

The water supply scheme arrangements for Onslow, Dampier and Port Hedland are all at, or near, capacity and struggling to cope with the existing demand. Newman has a source of groundwater which can support future anticipated growth.

The limited availability of water for expanding coastal communities is a significant regional issue. Meeting short-term and long-term demand will require a diverse, integrated approach to better management of water resources across all sectors.

WASTEWATER

Port Hedland and South Hedland, are serviced by two wastewater treatment plants. Newman, Onslow and Dampier each have one plant. All will require either upgrade or replacement to meet anticipated future demand, and some will also require re-location to allow for the urban growth of their towns.

There is a need to provide deep water sewerage facilities in all Pilbara cities and towns as well as provide adequate local absorption systems in the region's villages and Aboriginal communities.

STORMWATER DRAINAGE

The cyclonic conditions affecting Pilbara towns often results in heavy rainfall, storm surge and ocean inundation. Towns have implemented various methods of dealing with flooding, such as the swales in Dampier and the wide street drains in Newman. However, future planning must work with the natural topography to provide suitable siting of buildings and enable adequate drainage to minimise property damage.

ENERGY

Most Pilbara communities are serviced by the North West Interconnected System (NWIS) through a combination of the Pilbara Iron transmission network, the Horizon Power transmission network and private sector infrastructure.

Natural gas is the predominant fuel used for electricity generation. The gas is sourced through the Dampier to Bunbury Natural Gas Pipeline and the Pilbara Energy Pipeline. Currently, there is no reticulated residential gas supply.

Sufficient generation capacity on the NWIS grid requires urgent attention. Vision 2020 published by the Minerals Council of Australia (2009) noted that, although there was likely to be significant growth in electricity demand in the region, most of this is currently expected to be met by self-generation by industry rather than grid supply.

The report also notes that a cost competitive energy market is essential for the development of the Pilbara's energy intensive resource-based industry, and that the lack of an integrated electricity system in the Pilbara inhibits supply efficiency. However, the realisation of an integrated electricity system will require significant investment and cooperation between multiple stakeholders and will rely on the development of a strong commercial rationale.

Photovoltaic energy systems are particularly appropriate in the Pilbara because of the high number of days of sunshine. A photovoltaic system can power all electrical requirements in a building, alternatively, solar energy can be used for hot water heating only. Solar energy has not been embraced as readily as it should have in the Pilbara because of the high cost of transporting panels from Perth or further afield. Local and state governments need to consider incentives which would make solar energy more accessible to local residents and businesses.

WASTE MANAGEMENT

Waste in the Pilbara is primarily generated from domestic land uses; council and works including green waste from parks and road construction; and commercial/industrial activities. Appropriate facilities are needed to deal with the disposal of chemical/hazardous waste.

Unlike the Perth metropolitan region, most of the waste in the Pilbara is generated and disposed of by the private sector. Current waste management operations have varying standards and some are not operated to best practice standards, with a number of sites posing possible environmental and health concerns. In particular, there is lack of appropriate facilities to properly dispose of hazardous and household chemical wastes. High levels of contamination, the costs of recovery and the generally free access by households to dump trailer waste at landfills inhibit economically sustainable recycling operations. Green waste separation and treatment for use as mulch is not common.

Local governments collect waste from ratepayers, including commercial and industrial customers in townships. Periodic bulk and green waste collection services are also offered in major towns.

Harding Dam supplying Pilbara scheme water.

South Hedland wastewater treatment site.

Swales along the streets in Dampier for heavy stormwater events.

UTILITY INFRASTRUCTURE

TELECOMMUNICATIONS

Telstra is the dominant provider of both mobile phone and broadband services in the Pilbara region because of the limited network coverage of other providers. There is little competition and, where it does exist, it is usually in the major towns.

Mobile phone reception is generally poor or non-existent along the region's major roads and at roadhouses. Broadband access is problematic away from the major towns, with slower and less reliable satellite broadband often the only alternative.

Resources companies close to the optic fibre cable that passes through the region have good access to capacity for data and telephony, but at remote sites, capacity is limited.

It is anticipated that private telecommunications companies will continue servicing the Pilbara market. The State Government is in the process of extending remote mobile coverage along the North West Coastal Highway from Geraldton to Port Hedland by increasing the number of mobile towers. These towers will be operated by the private sector, but maintain a role in providing communications platform for emergency services and public utility providers.

The State Government is also planning to establish new facilities, known as Multi Function E-Centres, designed for use in remote locations, such as the Pilbara, for education, law enforcement, health and emergency services.

As part of the Federal Government's National Broadcast Network initiative, there is a $250 million budget to address black spots in regional Australia. The Pilbara is likely to be a priority region because of its forecasted rapid growth.

Broadband is considered essential to building new communities in the Pilbara because of the remoteness and vast distances between towns. Communities are at a significant disadvantage because of the current limited network coverage.[1]

Telecommunications tower at Port Hedland. This will be replaced by broadband in the near future.

Public telephones in Newman

ENERGY, WATER SUPPLY, WASTEWATER TREATMENT, WASTE MANAGEMENT AND TELECOMMUNICATIONS INFRASTRUCTURE WILL REQUIRE MAJOR UPGRADES OR REPLACEMENT IN ALL TOWNS. ADDITIONAL INFRASTRUCTURE WILL BE REQUIRED IN MANY TOWNS TO BOOST CAPACITY.

1 Pilbara Planning and Infrastructure Framework, 2011

MATERIALS AND CONSTRUCTION TECHNIQUES

When making decisions about building materials we can consciously try to select materials which have less negative impact on the environment. This needs to be balanced against the ability of the material to help create protected and comfortable living spaces.

Every design decision regarding choices of materials has a cause and effect on human comfort. The composition and characteristics of a material will determine its thermal properties and how it reacts under thermal conditions. The combination of materials also affects comfort levels.

The standard of construction further contributes to effective environmental comfort. For example, air gaps around door and window frames allow hot air to enter the building. Further, when materials and construction are combined with passive and mechanical ventilation and cooling methods, the performance of materials changes.

Availability and transport costs often determine the choice of materials in the Pilbara. Transportation of materials over long distances adds to the embodied energy of materials and thus their environmental impact. However, such considerations usually become secondary to financial costs.

There is limited manufacturing of building products in the Pilbara. Often contractors have little choice and must order materials and products from Perth.

MATERIALS FOR A HOT CLIMATE

In extreme climates, such as in the Pilbara, managing the effectiveness of building materials in reflecting heat, reducing the flow of heat and absorbing, storing and releasing heat (radiation, convection, conduction) is fundamental to providing comfort inside buildings.

Data can be found comparing the thermal properties of building materials and, even though these materials cannot be assessed in isolation, the comparisons provide a general guide to suitable materials for the Pilbara. For example, light colours have good reflectivity whilst a dark colour has poor reflectivity absorbing heat and contributing to the heat island effect.

LIGHTWEIGHT VS. HEAVY MASS CONSTRUCTION

The thermal properties of a material can have considerable affect on the internal temperature by delaying and reducing the transfer of heat from outside to inside. For example, light, air filled materials such as insulation bats have good insulation (low conductivity) properties but dense materials, such as brick and stone have high heat storing properties. They take a longer time to heat up but then hold their heat and take longer than overnight to effectively cool down. Lightweight cladding will heat up quickly but then cool quickly during the night when temperatures drop.

Heat lag is the time it takes for heat to be transferred through a building material. The denser the material, the greater its heat storage capacity, the longer it will take for heat to reach the inner surface. How a room is used should determine appropriate time lag; a bedroom can have a short time lag because of the cooler temperatures at night, but classrooms should have a 6-8 hour time lag and rooms used all day, such as offices, should have 9-12 hour time lag.

Masonry construction at Port Hedland airport terminal building

Lightweight construction in South Hedland. Steel frame on slab, house

Masonry construction in Newman

Lightweight steel frame with concrete blockwork. Townhouse development - Newman

Early single men's quarters are of masonry construction, Dampier

Lightweight steel frame on stilts construction in Onslow

PILBARA

MATERIALS AND CONSTRUCTION TECHNIQUES

METAL SHEETING

Metal sheeting has long been a popular building material for walls and roofs in the Pilbara because of its light weight, making it easier and cheaper to transport from Perth. It is durable, low maintenance and easy to install. Metal sheeting has low thermal mass and will cool down quickly at night. When used in combination with insulation, less heat is radiated into the building.

Colorbond finishes provide corrosive protection, but in coastal locations, particularly, Onslow where salt is harvested, corrosion can be very destructive. A metal sheeting with higher performance in extreme marine conditions, such as Colorbond Ultra, should be specified. Hot dipped galvanised steel, as a minimum, and, even better, 316i stainless steel are also required in these conditions for durability, although the higher cost of stainless steel might preclude its use.

In contrast, clay or concrete tiles are heavy and expensive to transport, as well as being unstable in cyclones. Even though longevity makes the life cycle cost more viable, roof tiles have high heat absorption properties and long heat lag. They are unlikely to be widely used in the Pilbara.

MASONRY

Masonry is best used in the Pilbara when shaded by wide verandahs, deep eaves, pergolas, wide canopy trees and mass vegetation.

Reverse brick veneer can be a effective mode of construction because the lightweight external material will heat up quickly and lose heat quickly whilst the masonry internal leaf will be slower to transfer heat, especially when it is shaded from direct sun by the outer veneer surface. The thermal mass of masonry is more effective if on the inside and insulated on the outside.

Concrete can be sourced locally from a concrete plant in Karratha. Cement is shipped in and can be used with local sand and aggregates.

There is a brickworks in Geraldton, 1,100kms to the south, and a small concrete block manufacturer in Broome, but most brick and concrete blocks come from Perth.

Steel is a preferred option for framework than timber, which because of its weight, has higher transport costs. Thermally, timber is a suitable material for cladding and has a lower embodied energy than metal cladding, but higher maintenance costs.

Vinyl frames have better thermal performance but can deteriorate in strong sun exposure and are not considered suitable for the Pilbara.

INDIGENOUS MATERIALS

Gravel, sand and rock can be found locally and can be used for stone walls, rammed earth wall construction and garden retaining walls. These materials also create minimal harm to the environment.

Local stone has been used in the past, such as the original buildings in Old Onslow. Today, its high thermal mass and thick wall construction could still be used to build durable, low maintenance buildings. To be a viable option, there would need to be a commercial quarry and stoneworks in the region. Like brick, stone walls need to be protected from direct sun to slow heat absorption.

Rammed earth construction has low production costs. However, it requires skilled tradesmen and currently this can be problematic in the region.

Metal sheet storage shed - Port Hedland

Metal sheet cladding on new town houses - Onslow

Locally sourced materials used to make clay, riverstone and gravel bricks - Old Onslow

Thick, highly durable sandstone sourced locally - Old Onslow

Rammed earth construction using local pindan soil - Port Hedland (left) and Newman

INSULATION

Insulation is an essential component in reducing heat transfer to the interior of a building. Air cavities will slow down the transfer of heat and soft fill, rigid or foam insulation in roof and wall cavities will assist in lowering internal temperatures. Insulation should be selected on its U-value and products are identified with this. Insulation with lower U-values contains a lot of air cavities. A combination of insulation batts (low heat transfer) and aluminium foil (reduced radiation) will further improve temperature control.

Foam insulation can be more effective because it spreads and fills cracks and cavities providing good sealing around door and window frames. Expanded polystyrene (EPS) is has better environmental credentials than other foams.

Ensure proper insulation around openings by using weather strips and caulking to seal around frames.

In hot, humid climates, such as Pilbara's coastal towns, natural wool insulation is preferable because it can absorb and store humidity without losing its insulation capacity. Rock or glass fibre cannot absorb humidity and its insulation capacity drops significantly and condensation can occur, causing mould.

OPENINGS

Apart from the roof, openings in a building envelope are the greatest source of heat gain. When designing the size, position and treatment of doors and windows in the building envelope, it's necessary to consider ventilation, volume of air flow and light quality whilst minimizing heat gain through solar radiation.

Providing shade, either natural or constructed, and orientation away from direct sun are effective ways to protect openings. Deep recesses, external blinds, shutters, awnings, deep eaves, wide verandahs, screens, trellises, canopies and pergolas can all be used effectively. Instead of clear glass, openings can be covered with solid panels or screens which allow air flow but filter or block sun from entering the interior. Narrow openings can provide the necessary ventilation and light to a room without the exposure to heat radiation which comes with large expanses of unprotected glazing.

Shading will also reduce glare which can be particularly problematic for people working on computers or watching television.

GLAZING

Heat transfer through glazed openings can be further reduced by specifying Low E (low emissivity) glass, double glazing and tinted glass. Specify total window and door U-values of less than 0.4Btu/hr-ft2-F. Double glazing has a U-value under 2.7 which is less than half that of standard six millimetre plate glass which has a U-value of 5.6. Additional substantial reductions can be achieved when combining Low E or double glazing with built shading devices and landscape shading. The additional cost should be weighed against the potential cost savings of running mechanical cooling.

Whilst aluminium is energy inefficient and has a high embodied energy, it is likely to continue to be used for glass door and window frames because of its ready availability, standardisation and light weight. A thermal break and insulation improves thermal performance by clocking the transfer of heat.

Timber and vinyl frames might be considered more aesthetically appealing and have lower thermal conductivity as well as a low embodied energy. However, they are more expensive and require regular maintenance, therefore, it is

Commercial building in Newman

Recently built house .in Newman

Pilbara TAFE building in Onslow

Original Newman house

Public building in South Hedland

Recently built house in South Hedland

unlikely that they will gain popularity in the Pilbara.

Glass blocks have good insulation whilst allowing light into the interior. However, their weight makes them more expensive to transport than lightweight materials.

FLOORS

Concrete, stone and ceramic tile floors will provide a cool surface internally when they are protected from direct sun. In inland hot, arid climates, such as Newman, where temperatures can drop significantly in winter months and exposing high mass floors to the sun will help heat the interior. Careful planning and design which uses the floor to absorb the suns heat can reduce a building's running costs for heating and cooling.

FINISHES

Choose finishes according to their reflectivity and heat absorbing properties. Light colours have good reflectivity whilst dark colours have poor reflectivity and absorb more heat, contributing to the heat island effect around buildings. Bright anodized aluminium sheeting has 90% reflectivity on average, absorbing only 10% heat gain, whilst asphalt has only 10% reflectivity, absorbing 90% solar heat gain.

LIGHTING

Lighting and electrical equipment contribute significantly to the heat in a room. Whilst we might not be able to select a low heat computer or television, we can select low heat emitting light fittings. Compact fluorescent lamps (CFL) use less power (typically one fifth) and have a longer rated life (six to ten times average) than traditional incandescent lights. The sale of incandescent light globes has been discontinued in Australia.

If a building's indoor incandescent lamps are replaced by CFLs, the heat produced due to lighting is also significantly reduced. In warm climates, especially when air conditioning is used for cooling, CFLs reduce the load on the cooling system, resulting in savings in electricity.

LED lights have many advantages over traditional incandescent lights, including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching and greater durability and reliability. However, LED lamps reach much higher temperatures than fluorescent and incandescent lights. LED fittings typically include heat management elements such as heat sinks and cooling fins. The cost of LED fittings is more expensive than incandescent and fluorescent fittings, however, the cost difference is decreasing as manufacturing technologies become more efficient.

LANDSCAPING

Conversely, large expanses of concrete, brick and concrete pavers, gravel and bitumen around a house will absorb heat and create heat islands which, in turn, will contribute to the heating of the house. It is preferable to keep hard surfaces shaded with a trellis, shade structure or trees planted along its sides.

Local plant species need less water and are appropriate for water-efficient landscape design as well as creating an empathy with the surrounding landscape.

Polished concrete floors provide a cool surface when protected from direct sun - Marrakech, Morocco

Ceramic surfaces are traditionally used as a cool wall and floor surface in shaded courtyards and interiors - Morocco

THE CHOICE OF MATERIALS FOR CONSTRUCTION IN THE PILBARA IS CRITICAL TO COPING WITH THE EXTREME TEMPERATURES AND CYCLONIC CONDITIONS.

PILBARA

OPPORTUNITIES AND CONSTRAINTS

PUBLIC REALM

WATER SUPPLY

CONSTRAINT

Many towns have potable water shortages.

OPPORTUNITY

Maximise Water Sensitive Urban Design (WSUD) developments and strategies.

Consider designs which include water saving strategies which can be readily implemented.

COMMERCIAL VIABILITY

CONSTRAINT

Existing retail and commercial facilities are too dispersed to benefit from co-location siting.

OPPORTUNITY

Town Centre Revitalisation planning can encourage infrastructure and civic facilities to support commercial and retail facilities by co-locating to build a stronger, more vital main street precinct.

COMMERCIAL DIVERSITY

CONSTRAINT

Minimal commercial land available to purchase within town centres restricts growth opportunities and competition.

OPPORTUNITY

Create well located and affordable land purchasing opportunities by rezoning as well as acquisition or relocation of obsolete and derelict buildings which are disused or abandoned and not contributing to the vitality of a town's commercial area.

TOURISM

CONSTRAINT

Long distances from main Australian cities.

Poor standard or limited accommodation and tourist amenities.

Expense of travel, especially airfares and accommodation.

OPPORTUNITY

Cooperative strategic development with WA Tourism to promote the Pilbara region as well as individual towns as destinations.

Rezoning to enable tourism development in prime locations.

EARLY SHORT TERM RESPONSES TO DEVELOPMENT IN THE PILBARA HAVE NOW CREATED A SITUATION WHERE CURRENT TOWN PLANNING AND INFRASTRUCTURE CANNOT COPE WITH THE NEXT WAVE OF POPULATION GROWTH.

HOUSING and BUILT FORM

INFRASTRUCTURE CAPACITY

CONSTRAINT

Current utility infrastructure capacity cannot meet future housing demand.

OPPORTUNITY

Promote Climate Responsive Design with sustainable initiatives to substantially minimise the reliance on and use of current utility infrastructure.

HOUSING COST

CONSTRAINT

Current housing demand is not being met which is increasing the cost of housing in the region, especially for lower income earners.

OPPORTUNITY

Developers and builders work with State government to create a more competitive market.

Develop smaller lot subdivisions and smaller houses.

Develop medium density dwellings.

Work with simple building techniques. Look at building practices which require less skilled labour.

Promote re-use/recycling of construction materials as a way of sourcing materials locally.

HOUSING QUALITY

CONSTRAINT

The building industry is currently unable to respond to the construction demand in the Pilbara. A shortage of builders and local skilled workers as well as the slow release of land for development, contributing to an imbalance in supply and demand which drives housing costs upwards. This has resulted in low quality housing that meets minimal standard requirements.

OPPORTUNITY

Develop housing types appropriate to Pilbara residents' needs.

Improve technical knowledge of materials and systems suited to Pilbara conditions.

Designs with more pre-fabricated components.

SHORTAGE OF ACCOMMODATION IS SEVERELY RESTRICTING SERVICE DELIVERY IN THE PILBARA REGION. GOVERNMENT AND BUSINESSES STRUGGLE TO PLACE QUALIFIED AND EXPERIENCED STAFF IN KEY POSITIONS.

PILBARA

Our preparedness to respond to future growth will be critical in whether the towns and cities of this region become desirable places not only to experience financial gain but also to experience living in a unique community. The following values and principles provide a framework to deliver Pilbara specific strategies that when applied will influence a way of living that is distinctive to the region and an alternate choice to living in Perth or other Australian cities.

These over-arching strategies should be read in conjunction with the individual strategies which respond to specific conditions in the towns of NEWMAN, PORT HEDLAND/SOUTH HEDLAND, ONSLOW and DAMPIER.

DESIGN VALUES

DESIGN PRINCIPLES

Responding to CLIMATE

- Control solar heat gain
- Encourage natural ventilation and air movement
- Minimise conditions which create heat islands
- Work to local conditions

Incorporating the NATURAL LANDSCAPE

- Respect topography
- Use vegetation, especially native vegetation
- Ensure biodiversity

Building on the PILBARA CHARACTER & IDENTITY

- Consider community-based art, culture and creativity
- Consider local character and design
- Work with Pilbara friendly materials
- Acknowledge informality
- Consider street life: content, movement and conviviality
- Identify opportunities for tourism

Enhancing LIVABILITY

- Ensure open space diversity
- Incorporate access and connections to open space
- Develop outdoor meeting and living places
- Design for water
- Diversify the built environment

MOBILISING for CHANGE

- Focus on town centre vitality
- Focus on local economies
- Create affordable housing
- Integrate new technologies

Responding to CLIMATE

PRINCIPLE: CONTROL SOLAR HEAT GAIN

Controlling solar heat gain should begin at the planning stage of subdivisions, public open spaces and circulation networks. The Pilbara towns are uncomfortably hot for many months of the year and design strategies are needed to provide shade for pedestrians and the facades and entrances of buildings. Orientation is a key consideration in this because building lots need to respond to the sun's path in order to maximise the effectiveness of solar heat control practices.

Public Realm

ORIENTATION

- Ensure the shape and orientation of lots maximise shading and minimise exposure of house walls and outdoor living areas to direct sunlight.
- In new development areas, cardinal lot orientation is recommended.
- Narrow lots, less than 12 metres wide, should be oriented on a north-south axis so neighbouring buildings can shade east and west walls. (Diagram 1)
- Lots more that 12 metres wide are better oriented on an east-west axis to reduce the surface area of eastern and western walls and limit heat ingress. (Diagram 2)
- Consider row housing for narrow lots to control exposure of external walls to direct solar gain. Use party or common walls or zero setbacks.

PEDESTRIAN COMFORT

- Activate town centres by making footpaths and public open spaces more comfortable for pedestrians.
- Provide shade using trees or built structures such as canopies, awnings, arbours, colonnades and pergolas.
- Use buildings to shade pedestrians by providing canopies and awnings over the footpath.
- Consider two separate circulation networks: one for pedestrians and bicycles, another for vehicles. This will more readily enable shading for pedestrians between buildings and under trees.

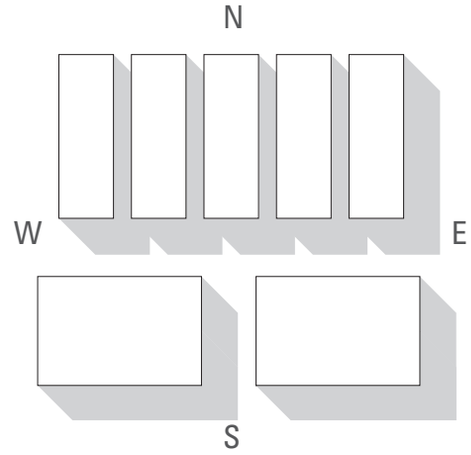
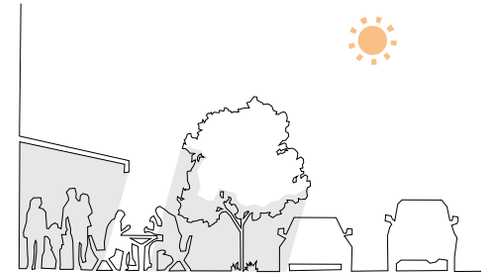
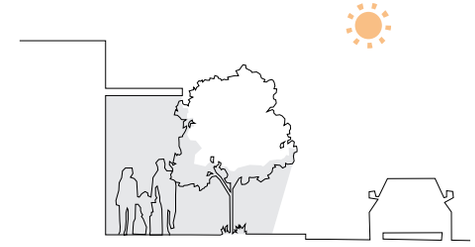


Diagram 1: Narrow lots oriented along a north-south axis provide shade on the east and west walls of neighbouring lots.

Diagram 2: Wider lots should be oriented east-west to minimise the area of exposed wall on the eastern and western facades.



Create places for alfresco dining and allow shop fronts to open onto foot paths



Separating pedestrian and vehicle circulation allows shading for footpaths from trees and buildings

Responding to CLIMATE

PRINCIPLE: CONTROL SOLAR HEAT GAIN

A building's orientation, siting and construction all affect thermal comfort. In an extreme climate, as in the Pilbara, the effectiveness of building materials in reflecting; reducing the flow; and absorbing, storing and releasing heat (radiation, convection, conduction) is fundamental to providing comfort for users. The composition and characteristics of a material will determine its thermal properties and how it reacts in changing thermal conditions. How materials are combined can also have a significant effect on comfort levels.

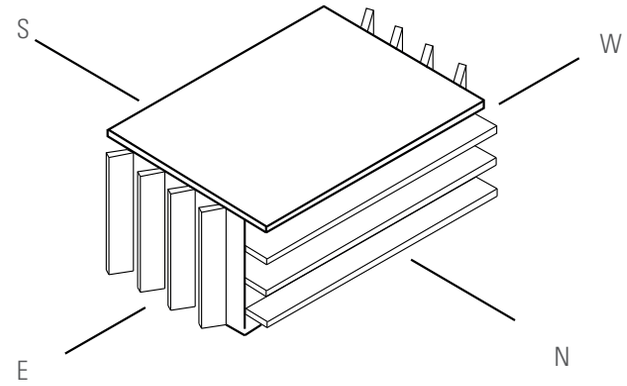
Housing and Built Form

ORIENTATION

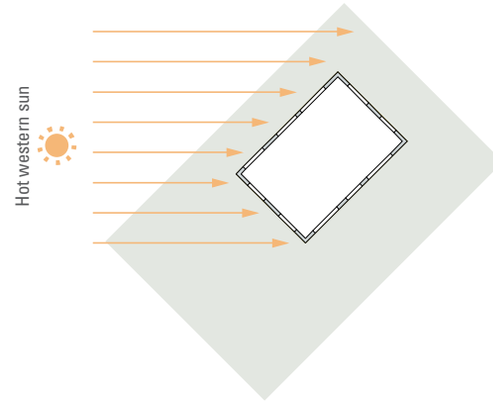
- Consider solar orientation when siting a house on its lot and maximise opportunities to control solar gain.
- Orient longer walls to the north and south, as these are the easiest to shade.
- West facing walls will be exposed to the afternoon sun and are likely to be the most effected by solar heat gain. Reduce the expanse of west-facing walls, windows and doors. When unavoidable, protect from afternoon sun by using vertical screens, trees or awnings.
- Orient first for sun then for wind, as breeze catching strategies can be incorporated into the design to assist with cooling.

SHADING

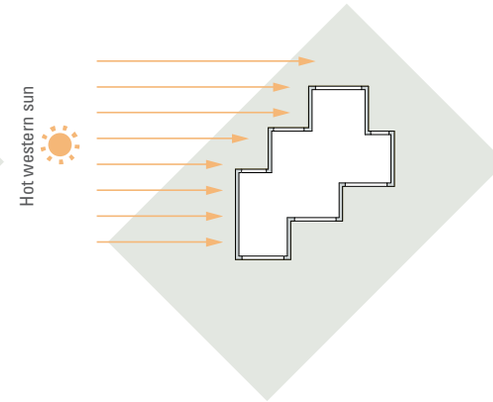
- Design for shading roofs, walls, windows and doors and outdoor living areas from direct sun using built shade devices or trees.
- Deep eaves, verandahs, pergolas, trellis and screens will protect openings from the sun.
- In two storey buildings, horizontal overhangs at first floor level shade ground floor walls and, when orientated towards cooling breezes, encourage air flow into the house.
- Make wall recesses to window and door openings as deep as possible to reduce glare and direct solar gain.
- Adjust the size of windows to suit the exposure to the sun. Narrow windows, particularly with deep recesses, can provide good quality light but reduce solar gain.



Horizontal and vertical shading devices should be used for different orientations



Windows inclined to the west are difficult to shade from the sun



Staggered walls which allow windows to face north or south are a simple design solution to western sun exposure

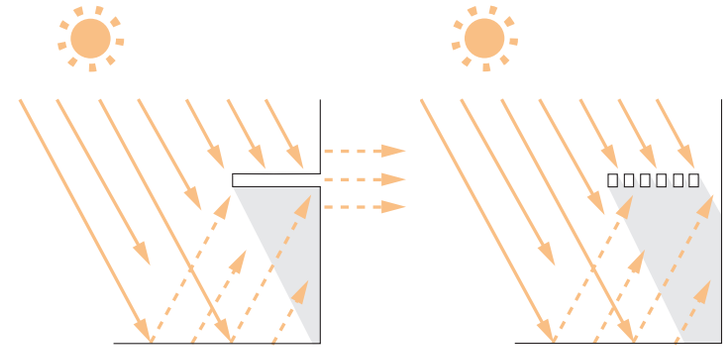
Responding to CLIMATE

PRINCIPLE: CONTROL SOLAR HEAT GAIN

Housing and Built Form

- Semi-translucent materials, such as polycarbonate and fibreglass panels, can provide sun protection whilst allowing light into a space. Panels with air cells are more effective. Review the different solar reflective properties of different colours and compositions.
- Use insulation with a foil backed radiant barrier under wall and roof cladding to reduce radiant heat transfer under the roof and in stud frame houses.
- Effective climate responsive design elements are often incorporated into public buildings, such as narrow, deep recessed windows, awnings over windows and entrances and roof vents. Incorporate similar elements into housing.
- Screens in front of an opening can be used to filter solar access to interior as well as reduce glare.

A contemporary example of a narrow, deep recessed window - Newman



Shading devices can increase the heat impact on a building. The can reflect heat into the building and trap hot air which can then be transferred inwards. This can be avoided by separating shading devices from the structure, using light reflective materials and by using open (louvred) shading

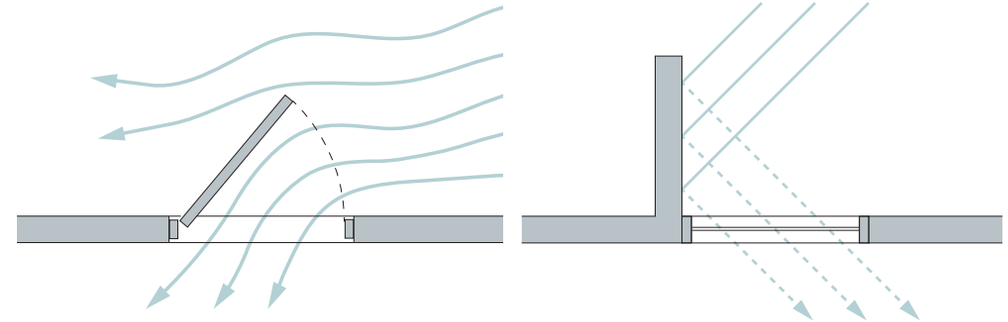
Responding to CLIMATE

PRINCIPLE: CONTROL SOLAR HEAT GAIN

Housing and Built Form

OPENINGS

- Reduce window sizes to minimise heat gain, especially on east and west walls. Aim for 15-25% opening in wall area on the sides.
- Long narrow openings can reduce the amount of glazing in a house but still deliver good ventilation and light to the interior.
- Incorporate indoor-outdoor spaces into houses. Breezeways, screened outdoor rooms and semi-enclosed verandahs can provide protected living areas with good air flow. In the evening, these spaces can be particularly cool and enjoyable.
- Openings for ventilation don't always need to be glazed or transparent. Timber, metal or fiber cement louvres, hinged panels and awnings can replace glazing.
- Design openings in the building envelope to a size and position for good ventilation, air flow and light quality. This doesn't need to be an expansive opening.



Casement windows and wing walls adjacent to openings on windward walls can be used to deflect air into a house (plan views).

Solid panel awnings over non-glazed openings show effective high and low level ventilation - Broome

Wing wall incorporated into wide eaves - Kununarra

Responding to CLIMATE

PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Air movement through subdivisions and houses is required for two key reasons: to remove air contaminants such as CO^2 and to provide cooling. Studies show that an air speed of 0.5 metres per second equates to a three degree drop in temperature at relative humidity of 50%.[1]

Studies show that high level wind speeds slow down considerably over urban development. Therefore, we need strategies to ensure natural ventilation and good air movement through subdivisions and built-up urban spaces.[2]

Public Realm

- In subdivisions, plan for single house lots to be staggered which then staggers the houses and enables more uniform air flow throughout the subdivision. It reduces dead air zones created by one house blocking air flow to the next house, which occurs in a traditional planning grid layout. (Diagram 1)[1]
- Road orientation which responds to wind directions can provide more opportunity for breezes to cool and ventilate houses. A principle for lot layout is that the cooling breezes will be most effective if the long axis of the lot runs across the breeze paths. (Diagram 2)
- Wide, shaded road reserves will help channel cool breezes to the front of houses. This is particularly valuable when density prevents breeze-cooled rear gardens. A front verandah can become a cool space.
- Choose trees with a wide canopy to increase shading over footpaths and to provide sufficient shaded space for seating. At the same time, allow sufficient air flow between buildings and trees along built up streets in retail and commercial centres. (Diagram 3)

BOUNDARY SETBACKS

- The inclusion of breeze corridors or easements between houses can assist in ensuring cooling breezes reach houses. These side spaces can also become cool outdoor living areas with the house walls providing protection from the sun. (Diagram 4)

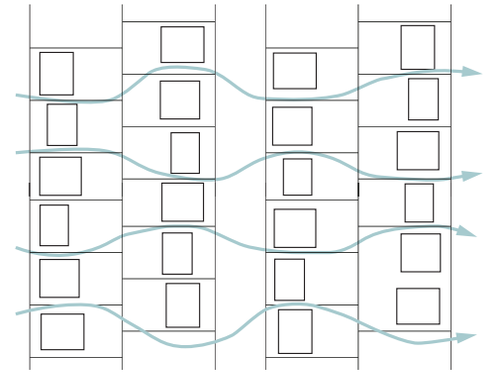


Diagram 1

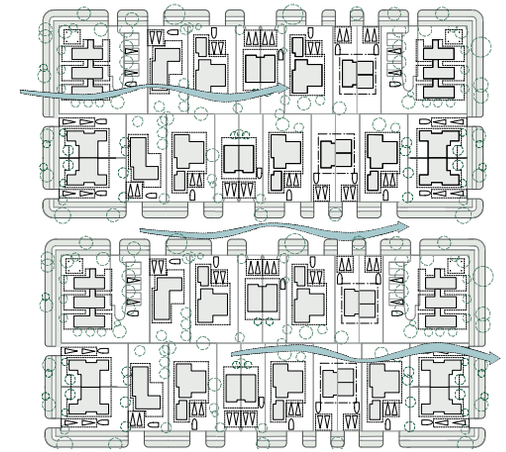


Diagram 2

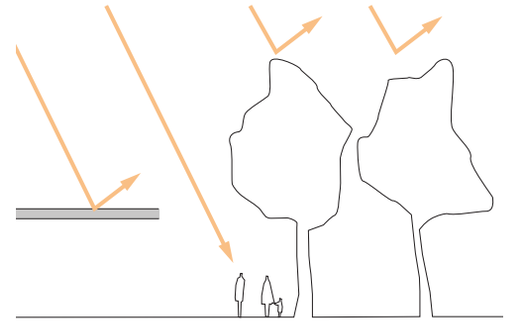


Diagram 3

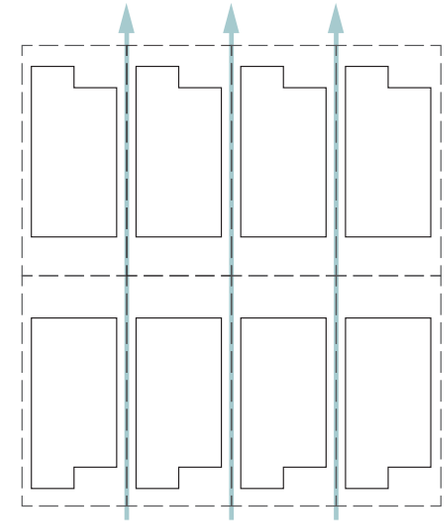


Diagram 4

1Your Home Design for Lifestyle and the Future,. Fourth Edition accessed June 2011, http://www.yourhome.gov.au/
2 Dr Richard Aynsley, Assessment of Climate Responsive Design 2007

1 Dr Richard Aynsley, Assessment of Climate Responsive Design 2007

Responding to CLIMATE

PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Public Realm

FENCES

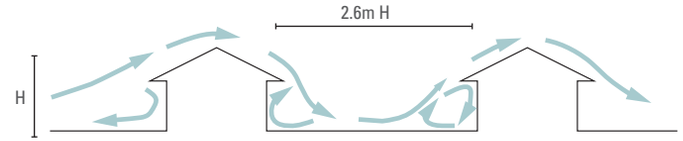
- Permeable fencing, such as metal mesh, metal rod spandrels and open weave screens, will increase the potential for breezes to reach a house and provide passive cooling. At the front of the lot, a permeable fence is also less of an inhospitable barrier between house and street.

SKIMMING

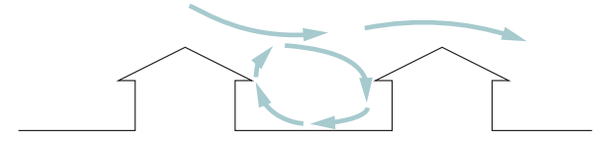
- It is critical to maintain wind speeds across a landscape of houses to maximise the effectiveness of cross ventilation. When wind hits the first obstacle, it rises and will skim across a series of closely spaced obstacles, reducing the potential for cross-ventilation. A minimum distance is required between obstacles (buildings) to achieve a reduction in the 'skimming effect' of wind. A rough, but accurate calculation, is 2.6m H where H is the height of the obstacle. In the case of a single house, this is about 5-6m to the top of the ridge line. It follows that a gap of 13-15 metres between obstacles is required.

Open fencing at this Port Hedland house provides security but allows breezes to flow across the lot

The fencing blocks breeze flow into the front yard and house - Newman



Desired outcome: Isolated Roughness Regime. Air flows over an object and descends back to ground level



Undesirable outcome: Wake Interference Regime. Air flows over the first object and impact the upper portion of the downwind object to create an eddy between the two

Responding to CLIMATE

PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Air movement is critical for human comfort in the Pilbara's hot, humid climate. Houses and other buildings should be designed to maximise the flow of air both through and around them. Natural ventilation will also significantly reduce the energy usage of mechanical systems.

The Mahoney Tables[1] used in this study tell us that daytime temperatures between May and September are generally thermally comfortable in Pilbara towns. During these months, mechanical cooling can be switched off and external windows and doors opened.

Housing and Built Form

- Design to enable air movement and natural ventilation through houses.
- Use open weave materials, such as perforated metal mesh, timber battens and trellis, for awnings and pergolas to enable hot air to flow through, rather than be captured and directed into the interior. Leave a gap between the wall and the shade material for air flow.
- Use walls to assist with drawing air into the interior by incorporating air ducts, vents and windcatchers.
- Use wing walls adjacent to openings along windward walls to deflect wind into the house
- Use hinge casement windows and doors on the downwind side of openings to defect breezes into the interior.
- Consider movable walls which can be adjusted to suit wind direction, particularly adapting to seasonal changes.
- Stagger external walls to control air flow.

HOUSE SHAPE

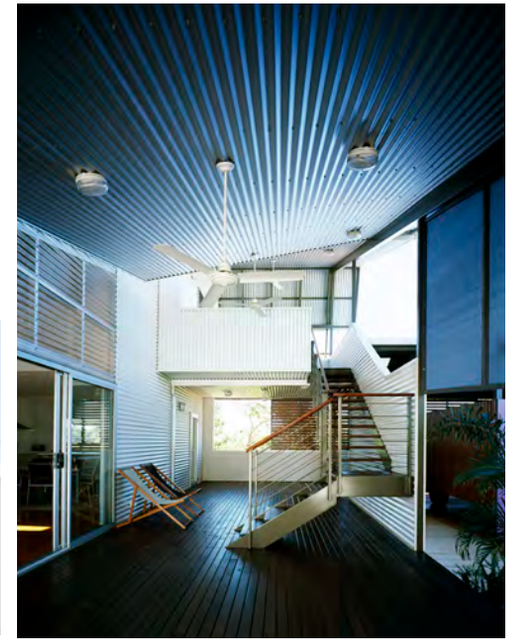
Use house shapes appropriate to the climate. Narrow planned houses provide the best internal cross-ventilation.

A pavilion house surrounded by deep eaves and verandahs to protect the external walls would respond well to the Pilbara conditions. The pavilion style house is characterised by a simple rectangular, box shaped volume, open plan interior. In more temperate climates, this style often has glass replacing much of the wall space. The advantage of glazing is that it can be orientated towards cool breezes and opened up

An older example of a semi-enclosed verandah with breeze permeable concrete blocks in Port Hedland

A contemporary sun protected verandah with breeze permeable composite aluminium screening to allow for breeze flow in Port Hedland

Examples of the various devices in use throughout the Kimberly to enable ventilation to internal spaces. Often these devices also perform as effective shade elements



Double volume outdoor living in Broome with ceiling fans, permeable screens and cross ventilation

1 Refer to Appendix: Understanding Climate for Energy Efficient or Sustainable Design, 2007

Responding to CLIMATE

PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Housing and Built Form

to cool the interior. In the Pilbara, glass needs to be well shaded.

- The preferred shape for a hot humid climate is an elongated rectangle with a ratio of 1:1.7 enables good cross-ventilation. (Olgyay, 1992). (Diagram 1)
- In a hot dry climate, a square, introverted design with rooms opening onto an enclosed courtyard is appropriate. The courtyard can be shaded by surrounding walls whilst enabling cross-ventilation to the surrounding rooms. (Diagram 2, 3)
- Both housing types can be adapted to provide separation between the sleeping area and the living areas which can be an important consideration for shift workers, common in the Pilbara.
- On narrow lots, or in row houses, a courtyard can be incorporated into a rectangular footprint to enable cross ventilation through more rooms.

PLAN

- Open plan encourages air flow through interior spaces rather than trapping air in enclosed rooms.
- Plan for a breezeways that allow air passage past rooms.
- Consider using partitions which stop short of the ceiling to create privacy and divide spaces but still enable air flow and cross ventilation.

ROOF

- Flat and skillion roofs surrounded by parapet walls will act as a scoop to channel air into a courtyard will encourage cool night air into the space and cool surrounding rooms.

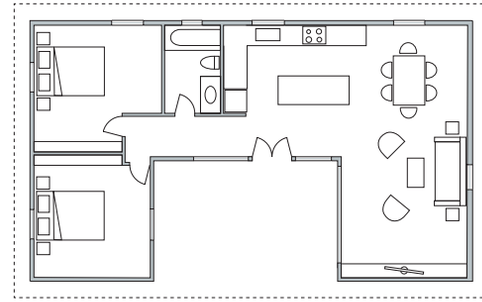


Diagram 1: Plan

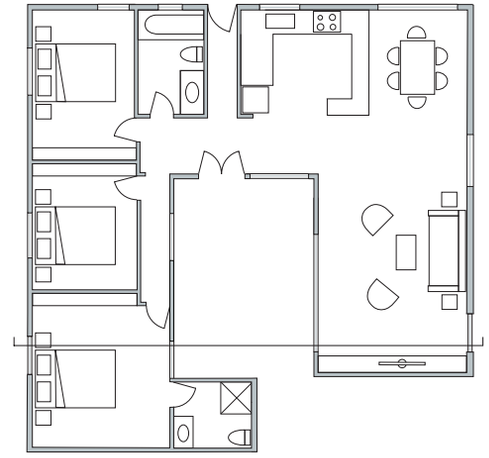


Diagram 2: Plan

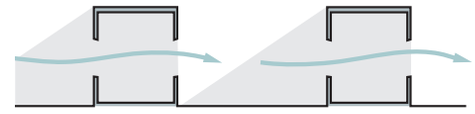
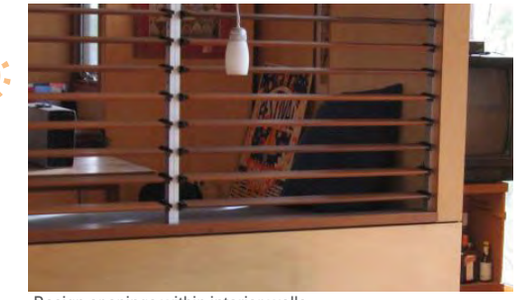


Diagram 3: Section

Original Broome covered verandah with permeable screens that blocks direct sun access, provides light and access to breeze

A breezeway allows for air flow past rooms



Design openings within interior walls

Responding to CLIMATE

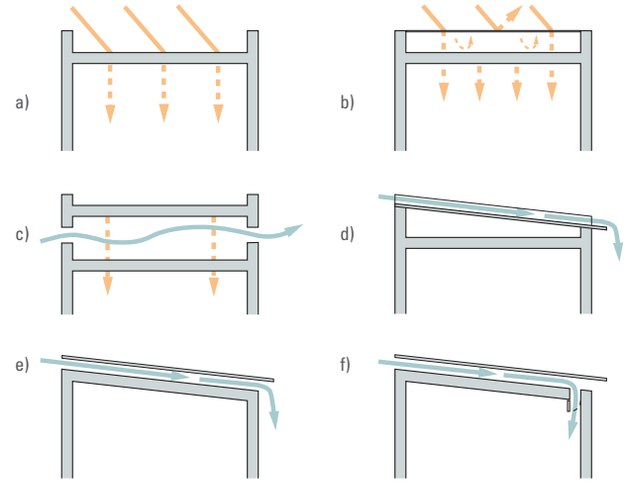
PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Housing and Built Form

- Ventilate the roof cavity so that hot air can escape, using either fixed louvre type vents or operable wind driven vents
- A sloped roof with openings to allow air movement to increase the cooling process.
- A roof elevated above a sub-roof will create a channel which directs air across the sub-roof, drawing heat away from the sub-roof as well as shading it.
- Orient roof slopes towards prevailing breezes to encourage air movement over the house.

CEILINGS

- High ceilings , preferably 2.8 metre high, allow hot air to rise well above the heads of the occupants.
- High ceilings will also improve the efficiency of ceiling fans. Fans which are offset (ie not centrally located in the room) will ensure better air currents and optimise cooling.



a) flat roof

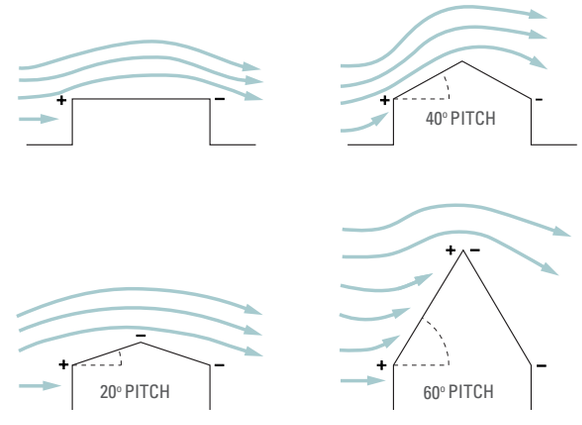
b) flat roof with reflective outer skin and air cavity

c) roof ventilation removing trapped heat

d) sloped roof with parapet

e) separated sloped roof allowing air movement

f) separated sloped roof with cool air movement directed inside



A roof's pitch effects the performance of roof mounted ventilation devices. At an angle of up to 21 degrees, double pitched roof will have a negative wind pressure (suction) on the windward side which can be used to draw out hot air. From 21-41 degrees there is a variation between negative pressure and a low positive pressure, dependent on the wind direction. At 60 degrees and over there will always be pressure on the windward side of the roof

Responding to CLIMATE

PRINCIPLE: ENCOURAGE NATURAL VENTILATION AND AIR MOVEMENT

Housing and Built Form

OPENINGS

- Place high openings on the leeward side of the house opposite lower openings so that air pressure draws in cooler air as hot air rises and escapes. Put wall openings on both the windward and leeward side. (Diagram 1)
- Large leeward openings create pressure differences which encourage more air to be drawn through the house.

WALLS

- Use wall shading such as screens and trellises with plant cover, to create a gap in front of the wall for air flow whilst shading the wall surface. (Diagram 2)
- Concrete breeze blocks and screens can provide privacy but still allow air flow into outdoor living areas.
- Use walls to assist with drawing air into the interior by incorporating air ducts, vents and windcatchers. Look to the Middle East and North Africa where windcatchers have traditionally been used to draw cool air into buildings.
- Use wing walls adjacent to openings along windward walls to deflect wind into the house.

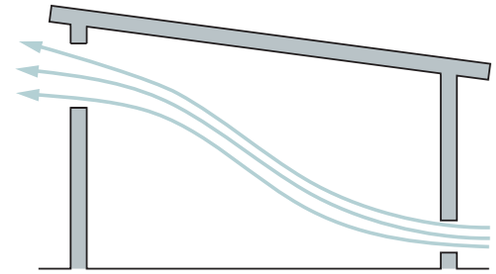


Diagram 1

Openings under the eaves allow hot air to escape. These openings have solid panel awnings to block late afternoon sun - Broome

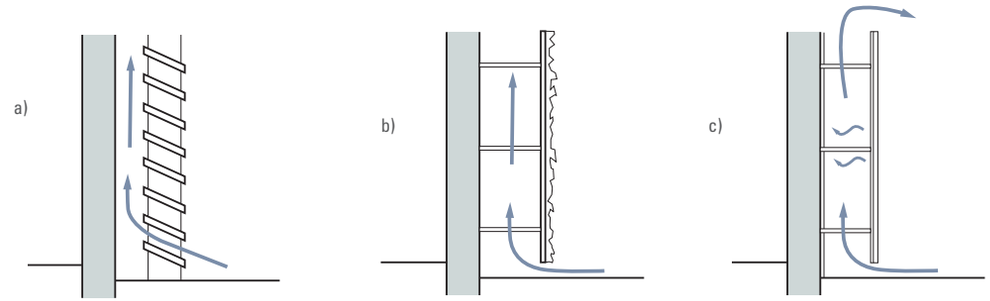


Diagram 2

Examples of wall shading devices:

a) louvres

b) vegetation on steel mesh

c) outer skin with heat reflective insulation on wall

Note: vegetation in humid climates may maintain or increase humidity.

Responding to CLIMATE

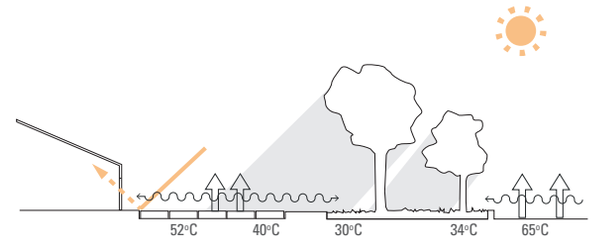
PRINCIPLE: MINIMISE CONDITIONS WHICH CREATE HEAT ISLANDS

Consider the effects of heat islands in the context of low density development and high density development. Both should use vegetation, shade trees and other devices to provide protection from heat gain. However, in higher density situations, careful planning can produce a more compact subdivision layout that allows buildings to act as the key providers of shade. The shaded mass that results re-radiates coolth back into the public spaces. This type is unprecedented in the Pilbara and, especially when combined with cross ventilation, is a viable planning option.

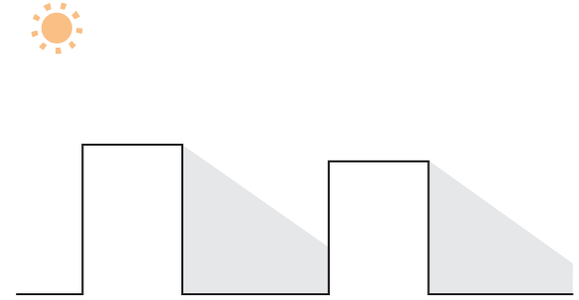
Public Realm

LOW DENSITY MICRO-CLIMATE

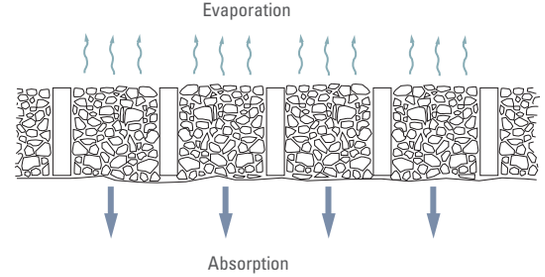
- Shade trees are an essential component in the streetscape and residential environment. A mature broad spreading canopy will provide cool shade over harsh paving materials and for passive activities, reduce ambient air temperature around the tree and act as an air filter in built up areas. Buildings, footpaths and bitumen absorb heat and create heat islands. Use trees, shrubs, grass and growing ground cover to create a micro-climate around buildings.
- Areas of commercial and mixed-use development should incorporate numerous shade trees and built structures. Paths should be edged with garden beds and expanses of hard grounds surface should be broken into smaller areas with vegetation.
- Ensure that lot layout and setback provisions allow sufficient space for wide tree canopies which will shade east and west walls .
- Permeable paving allows evaporative moisture exchange between the ground and the air and is encouraged.



Temperature inside and directly around the building is affected by the nature of the surrounding surfaces. Brick paving, concrete or asphalt will reflect, absorb and re-emit heat and cause a area of increased temperature around a building. Temperatures shown recorded at air temperature of 40C in a hot dry climate



Controlling the space between buildings allows for variations in shading, widely spaced buildings will provide shady areas and closely spaced buildings will provide shade to neighbouring buildings



Permeable or porous paving allows water to drain through its surface minimising the amount of water flowing through storm drains. It also allows evaporative moisture exchange between ground and air. The paving is often constructed of a metal, plastic or concrete mesh that is fixed to the ground and filled with aggregate. Soil or grass may then be laid over the top to give the desired finish. The paving is capable of taking heavy loads and studies show that it has the potential to reduce vehicle noise in low to medium traffic areas

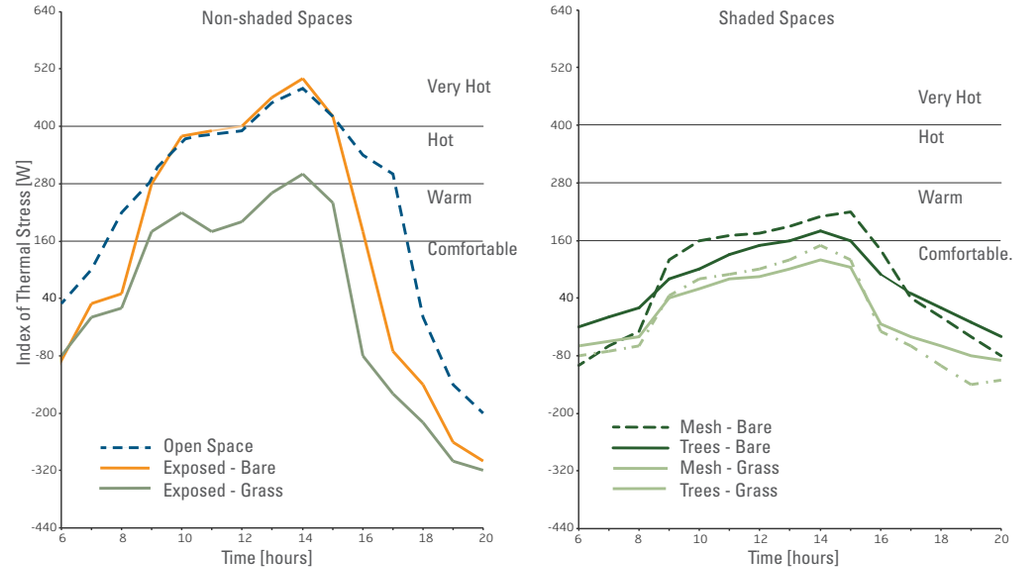
Responding to CLIMATE

PRINCIPLE: MINIMISE CONDITIONS WHICH CREATE HEAT ISLANDS

Public Realm

HIGH DENSITY MICRO-CLIMATE

- Think about how neighbouring buildings effect each other. The space between buildings is a good opportunity for vegetation to provide shady areas. Closely spaced buildings will provide some shade to adjacent buildings
- In higher density housing developments make use of public realm planting to help achieve a cool micro climate.
- Avoid large expanses of paving, concrete or black bitumen . Minimise hardscape footpaths and expanses of paved open spaces. Instead, use mulch and ground covers, light coloured gravel, bitumen or light coloured block/brick paving.
- Incorporate deep awnings to shop fronts to shade glazing and entrances as well as shade pedestrians on the adjacent footpath.
- Use built structures, such as overhangs, colonnades or awnings when trees will not provide shade to the footpaths and open areas of paving and bitumen.
- Bitumen absorbs heat. Break down car parks into smaller areas with trees and soft landscaping dividers. Provide shaded corridors connecting car parks to buildings. These will also provide shaded walkways from carparks to buildings.
- Car parking areas should include large trees planted in a regular grid between car bays to provide maximum shade to both the cars and the hard surfaces.



Comparison of comfort levels of difference outdoor ground surfaces

Awning over shop fronts in Port Hedland's West End main street

Traditional circulation routes in North African towns uses buildings to shade streets - Marrakech, Morocco

Responding to CLIMATE

PRINCIPLE: MINIMISE CONDITIONS WHICH CREATE HEAT ISLANDS

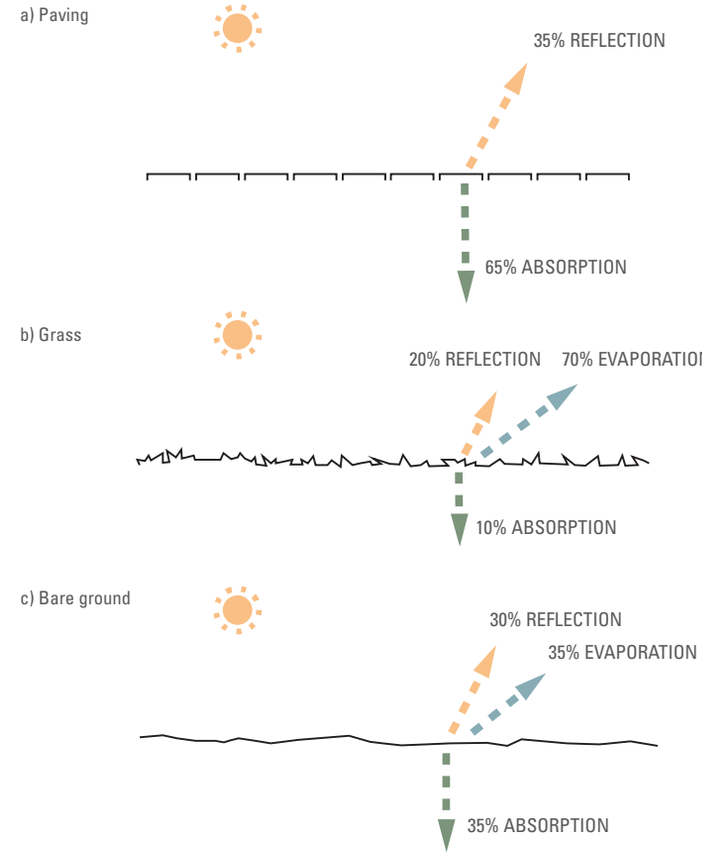
Controlling the amount of heat a house and its surroundings absorb from the sun is a primary consideration for maintaining a comfortable living environment and reducing energy consumption in the Pilbara. Reducing outdoor air temperatures will greatly improve the temperatures within a house.

A combination of elements can be used to create a cool micro-climate around buildings. Vegetation and shade structures, such as wide eaves, awnings and pergolas, minimise the amount of heat gained from the sun and thus the amount of heat able to warm the air. Vegetation, in particular, reflects little heat into its surroundings and has a cooling effect because of the transfer of moisture vapour from the foliage to the air.

Housing and Built Form

LOW DENSITY MICRO-CLIMATE

- Keep the sun off external walls, roofs and outdoor areas with hard surfaces by planting trees which provide good shade or use built structures such as, deep eaves, pergolas, arbors, verandahs and canopies.
- Orient shaded outdoor living spaces to maximise any cool prevailing breezes.
- Shading the paved or bitumen ground surfaces around a house will help the lower temperature. Use trees, pergolas, arbors and trellis with vines to protect external areas which generally have hard ground surfaces, such as courtyards, outdoor living areas and driveways.
- Use mesh, woven or batten screens for shade structures so that air can flow through and hot air is not trapped underneath.
- Reduce the areas of dark coloured hard ground surface around a building. Ground covers and light coloured gravels are preferable.



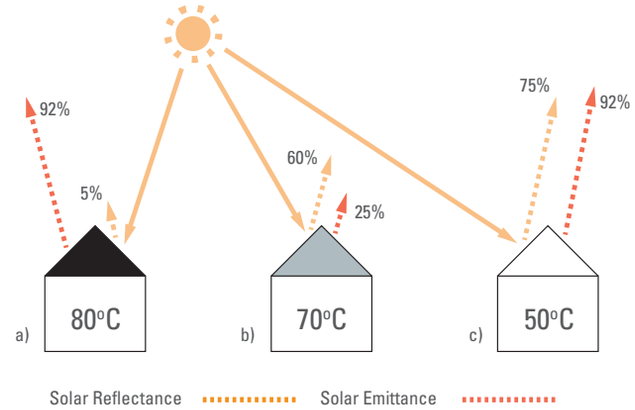
Variations in ground cover can have a huge impact on the amount of solar radiation that is gained or lost

Responding to CLIMATE

PRINCIPLE: MINIMISE CONDITIONS WHICH CREATE HEAT ISLANDS

Housing and Built Form

- Reflective, light coloured materials will absorb less solar radiation. For external walls and roofs, use light coloured or reflective paints and cladding, such as Zincalume and light Colorbond colours. Be aware of minimising glare to neighbours when using Zincalume or pale coloured roofing.
- Use a radiant barrier in the roof such as reflective foil. This will also assist with condensation on the underside of metal roof sheeting.

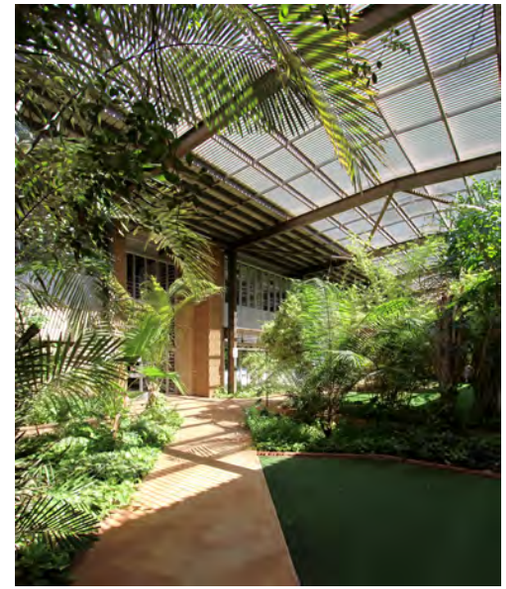


Combined effects of solar reflectance and emittance on roof temperature:

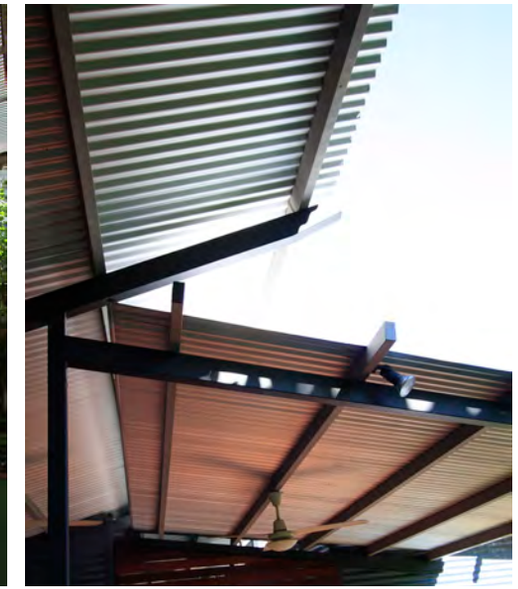
a) Dark (Colorbond or roof tiles) colour: low solar reflectance, high emittance

b) Aluminium (Zincalume)coating: high solar reflectance, low emittance

c) White or light coloured (Colorbond) coating: very high reflectance, high emittance



Large courtyards incorporating shading devices and vegetation are supplemented with wall mounted fans to maintain a cool temperature at Pilbara TAFE



Zincalume and light colours reflect the sun

Responding to CLIMATE

PRINCIPLE: WORK TO LOCAL CONDITIONS

Acknowledge the extreme Pilbara climate and work to create a public realm which is appropriate to these conditions. We cannot simply transfer design and planning practices from more temperate climates, such as Perth, and apply them to subdivisions and town planning in the Pilbara. We constantly need to be asking if pedestrians are being protected from the sun, how we can provide relief from the high temperatures, how we deal with flash flooding and inevitable seasonal cyclones, how we protect footpaths and open areas from dust and strong winds.

Public Realm

HEAT

- Acknowledge the Pilbara has a harsh climate and design in response to the climate.

DUST

- Future subdivisions and commercial developments should be planned away from known wind borne dust areas.

CYCLONES

- Acknowledge cyclone season conditions and incorporate cyclone defensive design into projects.

DRAINAGE

- Percolation construction for carparks can assist with in-ground stormwater drainage. For example, mix paving (Hydropave) and gravel in open weave concrete pavers over a geotextile membrane.
- Acknowledge water surge and ocean inundation in town and subdivision planning.
- Work with natural contours to assist with drainage.

ISOLATION

- Acknowledge distance and isolation by planning towns as welcoming destinations and creating a sense of arrival.

The planted dust buffer between industry and residential areas in Port Hedland

Heavy rainfall will quickly erode recently completed developments that have not had time to for vegetation to establish - South Hedland

Colorbond is the dominant material used for construction in the Pilbara but in areas of high dust regular cleaning is required - South Hedland

Responding to CLIMATE

PRINCIPLE: WORK TO LOCAL CONDITIONS

Pilbara's remote location and extreme climatic conditions impact significantly on the design and construction of housing. The selection of building materials and products is often restricted by the cost of transportation and shortage of skilled tradespeople. We can not simply transplant a house which would be suitable in a Perth suburb and expect it to perform effectively in a Pilbara town. We need to work with the climate and landscape and adapt traditional practices to create Pilbara responsive housing.

REFER TO THE PART 1: PILBARA 'CONSTRUCTION MATERIALS' PAGES FOR A BROADER DISCUSSION OF MATERIALS AND PRODUCTS APPROPRIATE TO THE PILBARA.

Housing and Built Form

HEAT

- Insulate, insulate, insulate. Ensure proper insulation around openings using a weather strip and caulking to seal around frames. Combine with eave overhangs, shading devices and landscape shading. The additional cost should be weighed against the potential cost savings of running mechanical cooling. Insulation foam is good because it fills gaps and cracks.
- Use staggered walls or blade walls to protect outdoor living areas from hot winds.
- Optimal positioning of ceiling fans in relation to other air flow sources is likely to offset the fan from the centre of the ceiling. When combined with a higher rotation rate setting, however, the air flow speed can direct air flow towards people.

RE-THINK AIRCONDITIONING

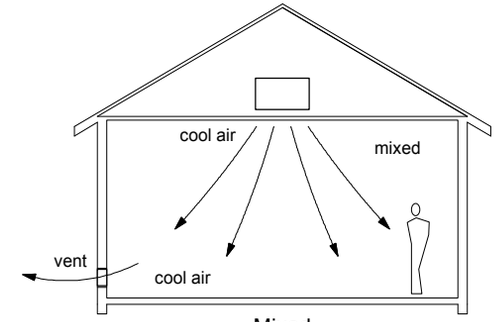
A combination of passive and mechanical cooling and ventilation will provide year round comfort. Natural cooling can be used for certain parts of the year or day, with mechanical systems working in extreme conditions. A combination of systems could be used simultaneously.

- Artificial cooling should be incorporated early into the design process as it will require different building construction. It is important to monitor and maintain airconditioning units to ensure they are operating a maximum efficiency.
- A building can be zoned for different internal cooling requirements such as mechanical air conditioning for the bedroom zone and passive cooling for living areas.

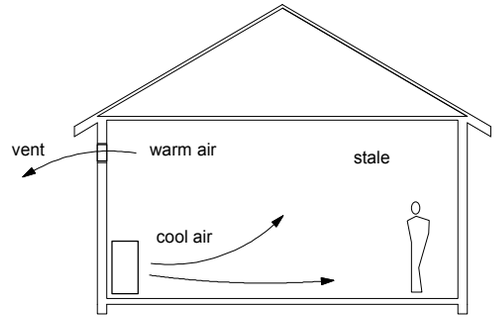
Shade, cross ventilation and protection from cyclones are all incorporated into the verandah of this Broome house

Combination of deep verandahs, shading devices and vegetation to shade both windows and walls in Onslow

Shade shutters on an original Port Hedland house



Mixed



Displacement

Conventional mixed mode air conditioning forces cool air into a room from above. Displacement air conditioning supplies cool air at a low level, displacing warmer air by encouraging to it rise naturally. As a result, displacement air conditioning is less energy intensive

Responding to CLIMATE

PRINCIPLE: WORK TO LOCAL CONDITIONS

Housing and Built Form

- Evaporative cooling is not appropriate in the hot, humid coastal areas because it cannot function efficiently in humid conditions. Refrigerant air conditioning is better suited.

DUST

- Acknowledge wind borne dust conditions and design for protection.

DRAINAGE

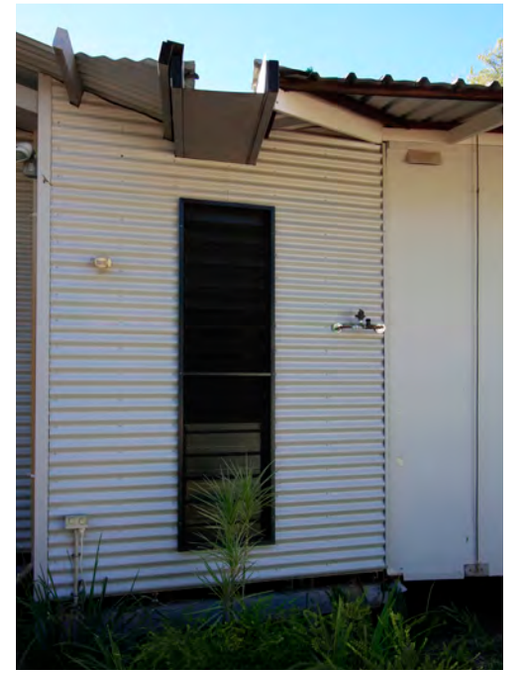
- Design to the topography of the lot, using natural falls of the land to carry stormwater away from the house, retaining walls and fence footings. Heavy deluges of stormwater can quickly erode soil and cause garden banks, fences and retaining walls to collapse.
- Where the town has swales and other stormwater collection systems, include these into a secondary lot drainage overflow strategy.
- Raise the floor on piles/stilts to avoid stormwater flooding.

CYCLONES

- Design using cyclonic defensive building systems. Contrary to popular belief, few houses are blown over in cyclones. Instead, they are pulled apart by winds moving swiftly around and over the building. This lowers the pressure on the outside and creates suction on the walls and roof, effectively causing the equivalent of an explosion.[1] It is not so much the type of materials, but how the material is used which determines its resilience in a cyclone.

Take advantage of the high number of sunshine hours in the Pilbara and use solar energy or hot water systems. Note dust build up on roof

The old hospital in Port Hedland uses, masonry breeze blocks to enable air flow and the brick conceals the dust accumulation on the exterior facade



Box gutter sized for heavy downpours of rain. Water flows straight into garden - Kunnunarra

Erosion as a result of not addressing roof drainage - Exmouth

1 Cyclone Resistant Building Architecture, 2007

Responding to CLIMATE

PRINCIPLE: WORK TO LOCAL CONDITIONS

Housing and Built Form

- Avoid a low pitched roof, use a hip roof or a high pitched gable roof. A flat roof will usually be subjected to larger uplift wind forces. Adequate roof tie-downs are essential.
- Overhangs or canopies need to be braced by ties back to the main structures.
- Build carport, verandah and patio roofs as separate structures rather than extensions of the main building so they wind forces can lift the roof independent to the rest of the house.
- Cyclone shutters can serve a duel purpose and provide shade to openings.

ISOLATION

- Weight up the advantages and disadvantages of materials. Few materials offer a perfect solution. However, some are more suited to Pilbara conditions and context than others. Cost, availability and delivery times weight against the suitability of materials and products for the Pilbara's climate. Local and state government need to consider incentives for materials and products suited to Pilbara conditions and they can be delivered to site more cost efficiently.
- Seek out locally sourced materials. Rammed earth and concrete can use local sand, aggregates and earth. Concrete can be supplied locally using cement that is shipped in.

For cyclone management separate carport roof from main roof - Broome

Separate outdoor living from main roof - Broome

Steel framed construction perform well in cyclonic conditions. Any weakness is usually in the connections

Tie downs across a sheet meet roof to prevent uplift during cyclones - Broome

Locally sourced stone was used in the construction of Old Onslow

Locally sourced stone used for garden mulch

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: RESPECT TOPOGRAPHY

Topography and landscape help frame the town and are important part of its identity. In any development, we should explore the natural contours and exposure of a site as these will influence how solar radiation gains, air temperature, wind and rain impact the site. Working with the natural contours will also help retain natural drainage and ecology. We should avoid leveling and grading to create uniform slopes for ease of construction or expedient planning as major grading can affect drainage with unknown consequences further afield.

Public Realm

NATURAL DRAINAGE

- Conduct a landform assessment and identify any micro-climatic conditions of the site including, low lying areas, water run-off and natural drainage; elements that should be retained; exposure to sun, rain and wind; trees to be retained; and ecosystems.
- Review broader topography and drainage patterns of the area to inform subdivision design and ensure there are no flow-on effects of earthworks beyond the site.

MINIMISE EARTHWORKS

- Position roadways, pathways and lot layouts along contours to minimise earthworks.
- Provide a partial flat area on sloping lots to enable a greater choice of building footprints on the flat or slope.
- Where possible, natural contours should be retained on lots to minimise earthworks and construction of retaining walls.

WIND ACTION

- Topography affects wind action. Use hills, valleys and windward slopes to maximise the cooling benefits of sea breezes or protect from hot land winds.

MAXIMISE VIEWS

- Retain topographical variety in subdivisions and offer different views and visual connections to the surrounding landscape.

Ensure future town centre development retains a visual connection to the landscape and the water - Dampier

Roads wind around the natural topography in Port Hedland

Newman is surrounded by the beautiful Hammersley Ranges

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: RESPECT TOPOGRAPHY

When designing or retrofitting a home, consider the effect siting has on micro-climate, such as its solar access and exposure to wind), as well as the potential to capture views. Ensure natural contours are maintained to conserve natural drainage channels and reduce erosion.

Housing and Built Form

MINIMISE EARTHWORKS

- Siteworks and demolition: preserve and protect the condition of the site as much as possible, work with natural contours, not against them to allow natural drainage.

NATURAL DRAINAGE

- Work with natural contours, not against them, to resolve stormwater run-off on sloping lots.
- Plant and build retaining walls within the natural contours of the land to reduce erosion.

WIND ACTION

- Consider the erosive effects of wind on land contours and avoid erosion of soil around retaining walls, fence footings and garden banks.

MAXIMISE VIEWS

- Site houses where they can make visual connections to the surrounding landscape and topographical features.

USE TOPOGRAPHY FOR THERMAL COMFORT

- On sloping sites, consider building into the ground to take advantage of the sub-surface cooler temperatures to keep rooms cool.

Use of local stone for landscaping and loose stone along the edge of the driveway are effective ways to provide good on-site drainage especially on a sloping site - Dampier

Nature provides magnificent vistas in the Pilbara. Position buildings so they can have visual connections to the surrounding landscape - Dampier

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: USE VEGETATION, ESPECIALLY NATIVE VEGETATION

Vegetation influences solar radiation gains, humidity levels, wind speeds and directions, in addition to acting as a screen to filter wind and sun. Most importantly, trees provide shade. The natural cover of a terrain tends to moderate extremes in temperature and stabilise conditions.

Plant and grass cover decrease temperatures and help stabilise the variances between high ground temperature during the day and low ground temperature at night. Plant and grass cover also decrease temperature, whereas buildings, footpath and bitumen, absorb heat and create heat islands.

Town planning can demonstrate a long-term commitment to effective landscaping practices by implementing extensive landscaping works within the urban realm. In time, this can influence private homeowners and help them to understand the value of vegetation in creating a more a comfortable living environment, particularly through the use of landscaping to create shade.

Public Realm

PLANT FOR PROTECTION FROM SUN

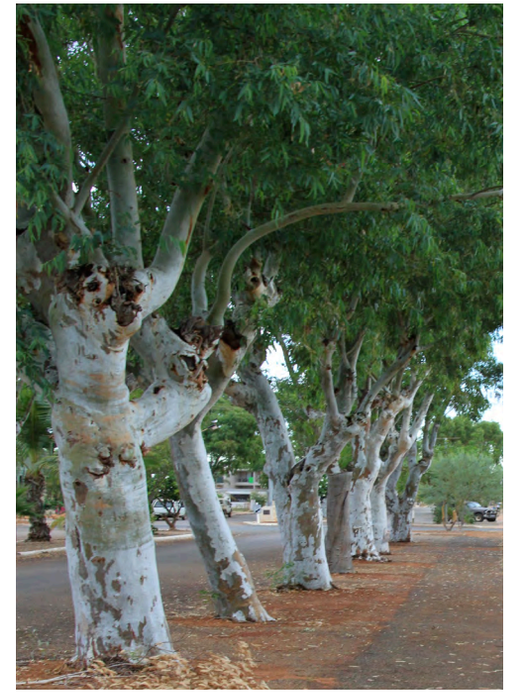
- Plant trees along footpaths to encourage people to walk.
- Ensure significant shade trees are retained when developing subdivisions or public spaces. Identify their value to the community by using a maintenance and risk management strategy to implement this.
- Incorporate landscaping for all transport corridors for cooling hardscape as well as improving streetscape vistas.
- Choose trees that have a wide spreading canopy that maximises shade coverage. Ensure there is sufficient area around trees for growth through to full maturity.

PLANT FOR SITE CONDITIONS

- Match plants to site conditions. As well as soil type and rainfall consider special conditions such as cyclone resistant tree species and salt resistant species on the coast.

CREATE BUFFER ZONES

- Use vegetation buffers to protect openings from strong winds and wind borne dust.
- Earth berms have a dampening effect on noise. Combine these with vegetation to further reduce noise.



Onslow's beautiful eucalypts along the main street provide good shade to pedestrians and cyclists

Recently planted exotic trees with wide canopies - Port Hedland

The vibrant Sturt's Desert Pea grows throughout the Pilbara region

Podalyria calyptrata planted in Karratha

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: USE VEGETATION, ESPECIALLY NATIVE VEGETATION

Public Realm

PRESERVE EXISTING VEGETATION

- Provide information about plants which are appropriate to the region on shire websites.
- Use local native vegetation to reduce reliance on water, improve biodiversity links with the surrounding landscape and contribute to evoking a sense of place for the town.
- Preserve existing trees during construction.
- Ensure significant shade trees are retained. Use a maintenance and risk management strategy to identify and ensure their value to the community.

INFILL PLANTING

- Identify areas of existing verge trees in town centres and plant additional trees between existing trees to create a continuous coverage along streets and footpaths.
- In new development areas, plan for whole lot retention of vegetation and natural contours whenever possible,rather than levelling and clearing the entire site. Whilst clearance is required for construction of roads and installation of services, lots should be allowed to retain existing vegetation. A rebate package could be then offered to encourage developers and new lot owners to work to minimal clearing of the lot around the building footprint only.

Choosing plants with a wide canopy will provide more shade when the trees mature

Tree lined streets will provide shade to road surfaces helping to maintain cool temperatures along transport routes

Groups of native, drought tolerant plants will reduce water consumption

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: USE VEGETATION, ESPECIALLY NATIVE VEGETATION

Around individual buildings, vegetation can be used to provide shade, reduce solar heat gain and buffer against wind borne dust and sand. Thoughtfully selected native vegetation can do this as effectively as exotic species and is often better able to cope with local conditions.

Housing and Built Form

PLANT FOR PROTECTION FROM THE SUN

- Plant large shrubs or trees on the east and west of each lot to block morning and afternoon sun.
- Choose trees that have a wide spreading canopy to maximise shade coverage. Ensure there is sufficient area around trees for growth through to full maturity.

PLANT FOR SITE CONDITIONS

- Match plants to site conditions. As well as soil type and rainfall consider special conditions such as cyclone resistant tree species and salt resistant species on the coast.

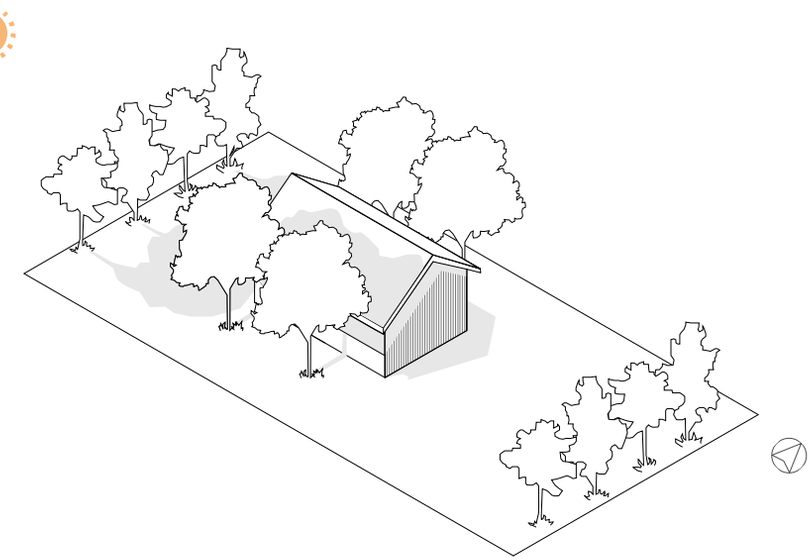
USE BUFFER ZONES

- Use vegetation buffers to protect outdoor living areas, doors and windows from strong winds and wind borne dust.
- Conceal fencing with vegetation. Use plants with a less dense foliage along permeable fences so that air flow is not blocked.

PRESERVE EXISTING VEGETATION

- Identify existing trees to be retained on a lot and protect these trees during construction.
- Consider roof gardens. Cool evening breezes which might not reach the interior of a building, can often be enjoyed on the roof.

This Dampier house nestles unobtrusively into the surrounding landscape



Tall shade trees close to the north and south of the house provide shade at midday without obstructing breezes. Lower trees and bushes to the east and west , and set back further from the house provide shade in the morning and afternoon when the sun is low in the sky

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: ENSURE BIODIVERSITY

A diversity of vegetation is essential to create a habitat for wildlife within towns. Creating interlinked habitats will further increase the biodiversity of open spaces by enabling local migration between habitats which, in turn, will create more interesting and enjoyable outdoor areas for people.

Public Realm

PROTECT FLORA AND FAUNA

- Pursue the long term protection and management of natural areas through preparation of a local biodiversity strategy consistent with WALGA's Local Government Biodiversity Planning Guidelines (2004).

INTEGRATE BIODIVERSITY

- Use drainage systems to plan public open spaces (POS). Where there is no drainage requirements, strategically locate POS to create biodiversity linkages through the town.
- Identify established biodiversity corridors to ensure future development has access or links into them.
- Include water and local vegetation which will attract, wildlife especially birds, in urban development.
- A mixture of created and natural retained landscape should make up the balance of POS and recreation spaces.

CHOOSE LOCAL

- Encourage use of local plants in the public realm and use these plantings as an example to residents of the beauty of local plants.

GLAZING

- Public buildings need to carefully place large areas of glazing. When the glass mirrors the surrounding landscape birds often fly into it.

Incorporating the NATURAL LANDSCAPE

PRINCIPLE: ENSURE BIODIVERSITY

Future grown of Pilbara towns needs to be sensitive to the unique biodiversity of the region. Biodiversity can be encouraged on an individual lot scale by planting and protecting native vegetation and employing local materials.

Housing and Built Form

CHOOSE LOCAL

- Offer tubestock local native vegetation to residents to encourage individual lots to plant environmentally sustainable food for fauna. This could be offered by developers of new subdivisions and shires in conjunction with builders.
- Many Pilbara towns has endemic landscape surrounding the town, ensure domestic pets are controlled to avoid harming native fauna.
- Gravel, sand and rock can be found locally and can be used for rammed earth wall construction, stone walls and garden retaining walls.

Local stone used for informal garden retaining walls - Dampier

Offer tubestock of local native vegetation to encourage private planting of food for the fauna

Large areas of glazing, especially reflective glass, can be hazardous to birds

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: CONSIDER COMMUNITY ART, CULTURE AND CREATIVITY

Art, culture and heritage play an import role in preserving and developing identity in towns and are woven into the social fabric of the place. Some Pilbara towns have managed to develop a strong creative network and this has benefited these towns immensely, but there is more to be achieved.

Public Realm

SHARE RESOURCES

- Promote local community groups through integrating and locating activity centres adjacent to local school or after school care facilities to encourage a synergy between the different functions.
- Locate after-school care adjacent to local library to provide access to this facility and to the wider local community.

RESPECT SACRED SITES

- Minimise the disturbance of sites significant to aboriginal people and the remnants of early non-indigenous occupation.
- Look for interpretative landscape opportunities that promote the culture of the land's traditional owners.

ENCOURAGE LOCAL ART

- Establish an Artist Relocation Strategy by offering cultural and financial incentives to encourage artists to set up their home and studio in the town.

School children participating in public art - Onslow

Statue of prospector Stan Hilditch and wife Ella - Newman

Mural - Onslow

Community art - Newman

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: CONSIDER LOCAL CHARACTER AND DESIGN

A Pilbara vernacular will grow from future development which acknowledges each town's unique context and local community values, not only drawing on the landscape and built form, but also on the lifestyle of people living in the towns.

Public Realm

- Review the history and strategies of past planning densities and strategies reasons to determine if they are still relevant and how they can influence future development or if a different approach us required.
- Identify, assess and protect buildings and sites of historical and cultural significance. Celebrate these sites and make them known to residents for their role in development of the local community.
- Encourage protection and preservation of sites with local historical importance. Shires can encourage locals to participate in maintaining these sites by organising community volunteer groups.
- Identify the combination of forms, textures, scale, and materials which contribute to the distinctive character of the area.
- Look to the Pilbara landscape for inspiration from the colours, textures, light and land forms.

National Australia Bank building - Port Hedland

The natural landscape on the fringe of town - South Hedland

A designed park referencing the local landscape - South Hedland

DESIGN STRATEGIES

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: CONSIDER LOCAL CHARACTER AND DESIGN

Buildings can reinforce the Pilbara's unique identity through referencing earlier design elements and building techniques as well as actively responding to the climatic and geographic conditions of the region.

Housing and Built Form

- Consider re-use of demolition materials which speak of past building traditions as well as being positive sustainable practice.
- Consider designing outdoor living and sleeping areas which support a lifestyle which suits local conditions. (Diagram 1 and various adaptable options and responses to seasonal climate conditions for this plan).
- Consider time-honored and familiar building elements such a perimeter verandah particularly when building in masonry.

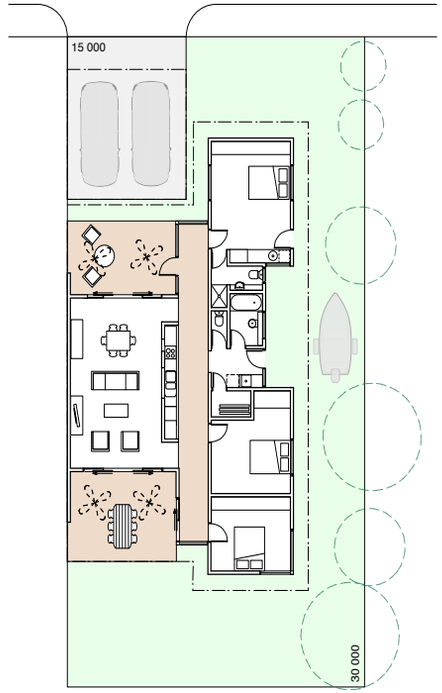
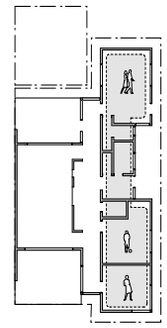
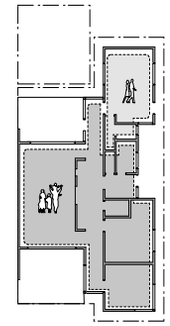


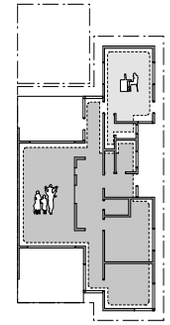
Diagram 1



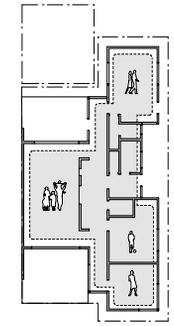
ADAPTABILITY 1
Family Home:
Three bedroom House with extensive outdoor living. Large master bedroom at front includes ensuite, ktichenette and adjacent outdoor living area.



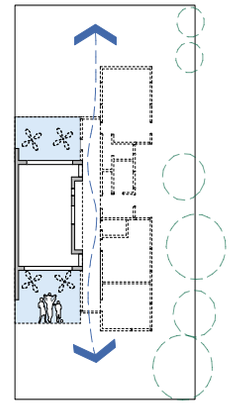
ADAPTABILITY 2
Shared house/Cultural:
Self contained room at the front of the house with a seperate entry and outdoor space. House responds to shared households and cultural rules by allowing for independence of occupant groups



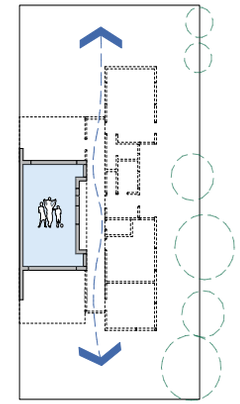
ADAPTABILITY 3
Live/Work:
Fully contained home office at the front of the house with a seperate entry, allowing for complete seperation of home and work environments.



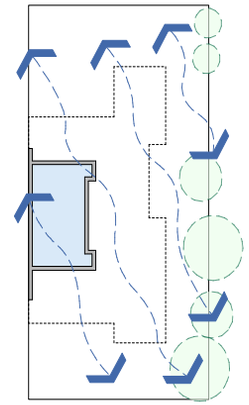
ADAPTABILITY 4
Extended Family:
Mattresses can be taken from the store room and used in the living space (and outdoor decks) when extended faily come to stay



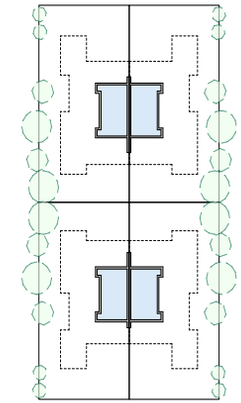
DRY SEASON
Living spills outdoors to the north and south. Central breeze-way and sleeping wing open up for maximum ventilation



WET SEASON
Living retreats to the air-conditioned core. Ventilation still provides some relief



ZERO LOT
Large side set backs provide breeze path to lot layout. Planting in setback provides a buffer zone



COOL CORE
Repetition of house design with zero lot alignment creates cool-cores fully shadded by surrounding light-weight house construction

Note: Diagrams demonstrate intent of design strategies and do not override any requirements of local town planningg schemes, subdivision desgin guidelines, DAPs, R-Codes and BCA.

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: WORK WITH PILBARA FRIENDLY MATERIALS

Material selection for urban design in the Pilbara must respond to the isolation and harsh conditions. Durable, low maintenance materials, preferably those that can be procured locally, will be better suited to the unique requirements of Pilbara towns.

Urban Realm

DURABILITY AND LONGEVITY

- Choose durable materials that can withstand the unique conditions of each town. Consideration must be given to factors such as heat, salt and corrosion, cyclonic wind and rainfall, flooding, sand and dust.
- Consider the maintenance requirements of materials and their appropriateness for use in high traffic public areas. Low maintenance materials are preferable for high traffic public spaces as the ongoing costs and time associated with high maintenance materials could be better resourced into other urban projects.

EASY ACCESS

- Consider sourcing materials locally. Materials such as gravel, rock, sand and shells, are readily available throughout the Pilbara and are often well-suited to cope with the region's extreme conditions. Using local products also reduces the cost and energy associated with material transportation and provides a reference to the town's local context.

Colorbond is used throughout the Pilbara - Dampier

Local stone used in Port Hedland

National Australia Bank building - Port Hedland

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: WORK WITH PILBARA FRIENDLY MATERIALS

Freight costs, climate and shortage of skilled workers are key influences in the choice of materials in the Pilbara. Therefore, it is not surprising that lightweight construction is popular. However, when we look at examples of housing in the Pilbara to date, there is often a lack of climate responsive design and residents instead rely on mechanical air conditioning to cool them on hot days. Air conditioning should be considered as a supplement to good climate responsive design on extremely hot days.

REFER TO THE PART 1: PILBARA 'CONSTRUCTION MATERIALS' PAGES FOR A BROADER DISCUSSION OF PILBARA FRIENDLY MATERIALS.

Housing and Built Form

DURABILITY AND LONGEVITY

- Materials which work well in the Pilbara should respond the challenges of the hot climate, the cyclone season and the harsh environment. Look for materials which offer longevity, particularly when they are used in extreme conditions exist such as wind borne salt in the coastal towns.
- Use materials with durable pre-applied finishes such as Colorbond, Alucobond and hot dipped galvanised steel members.
- Specify materials which have guarantees to withstand strong solar conditions, especially paints.

EASY ACCESS

- Choose materials which are easily accessible in the Pilbara towns, particular those that can be sourced through local suppliers.

EASY CONSTRUCTION

- Design with materials and building systems which do not necessarily require highly skilled and experienced tradespeople, especially construction which can be undertaken using a skilled and experienced supervision. Using pre-fabricated components can be useful to overcome skills shortages.

Rammed earth construction using local pindan soil, South Hedland

Ubiquitous corrugated metal sheeting, Port Hedland

Local stone berm walls at Pilbara TAFE, South Hedland Campus. Note the shaded blockwork and perimeter drainage at the base of the retaining wall

DESIGN STRATEGIES

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: ACKNOWLEDGE INFORMALITY

Pilbara towns are well known for their informal lifestyle expressed in their casual dress, barbecues and informal socialising. This is undoubtedly a response to living in a hot climate and working hard, sometimes for long shifts. We should acknowledge this informality as an intrinsic part of life in the Pilbara and continue to respond to this informal relationship between the natural and built environments.

Public Realm

OUTDOOR LIVING

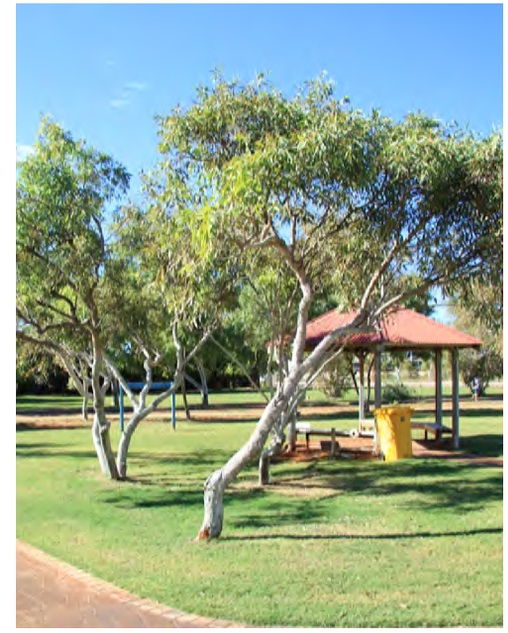
- Look for everyday aspects of living in the Pilbara which make it unique and design to accommodate these.
- Think of outdoor spaces as an extension of internal living spaces. Allow for outdoor areas which can be used in the evening when the heat of daytime temperatures eases.
- Provide facilities for outdoor activities such as barbecues, taps, picnic tables and benches in parks and recreation areas.
- Provide lighting in public spaces so that people can use these spaces in the evening when the heat of the day builds up in houses and residents move outside into the cooler night air.

CONNECT WITH THE LAND

- Maintain in the growth of the town the physical and visual connections.
- Acknowledge and accept our native trees are messy and often have a habit that is bent by the windy climate.
- Allow nature to penetrate into the town centres.
- Retain unsealed roads.
- Acknowledge the popularity of places which locals have adopted for activities such as fishing, trail bike riding and four wheel driving. Retain these as recreation areas.
- Retain areas which are used by local indigenous people and ensure they are protected.

A communal pizza oven in Onslow

Unsealed rear lanes in Onslow



The abstract form of native trees gnarled by the prevailing breezes create a natural informality - Exmouth

Tracks through undeveloped land to the town are popular choices over concrete footpaths - South Hedland

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: ACKNOWLEDGE INFORMALITY

Houses and other buildings can acknowledge and support the informal lifestyle of Pilbara towns through encouraging a relationship with the outdoors.

Housing and Built Form

OUTDOOR LIVING

- Blur the transition between interior and exterior spaces. Create areas for outdoor living which protect the users from the sun, hot winds and rain. Consider that these spaces can be used in the evening when the heat of the day builds up in the house and residents move outside into the cooler night air.
- Provide outdoor cooking facilities such as built-in barbecues and pizza ovens.

CONNECT WITH THE LAND

- Maintain an informal approach to landscaping so that the house and its lot can make a easy connection to the surrounding natural environment.

Creative interpretation of outdoor living space using local stone - Dampier

An outdoor living area designed for comfort in a hot climate - Broome

The residents of Dampier use the swales between their lots and the street as an extension of their rear yard when the swales are not performing as stormwater drainage channels

Building on the PILBARA CHARACTER & IDENTITY

PRINCIPLE: CONSIDER STREET LIFE - CONTENT, MOVEMENT AND CONVIVIALITY

One of the key requirements for creating an energised town is to offer places which enable a variety of experiences, such as for informal meeting places, street markets and comfortable places to sit, eat and people watch. These all facilitate a sense of belonging and identity, as well as interaction between residents. In town centres, this means activating the edges so that the vitality and energy of the centre reaches out to surrounding streets and draws people in.

Public Realm

- To encourage more people to utilise the public realm more activities need to be offered, as people attract people.
- Look for a balance between vehicles and pedestrian circulation. The centre of most of the Pilbara towns is not a through road. Vehicles generally need to turn off the main road to arrive at the town centre. Therefore, it is a feasible that pedestrians could have priority in town centres.
- Ensure footpath width is scaled to facilitate different types of pedestrians such as parents with prams, people walking their dogs, school children with backpacks, elderly people with walking support, as well as landscape treatments and street furniture.
- Encourage residents to utilise the streets. By ensuring the public realm is conducive for pedestrians, streets can become more inviting for a range of activities such as walking to work, daily shopping, meeting with friends, exercising, chatting with neighbours.
- Consider how to link urban functions, people and activities at specific locations.
- Allow shop fronts to open onto footpaths and encourage transitional spaces between interior and exterior.
- Create places for *al fresco* refreshments and dining on footpaths in the town centre.
- Provide continuous protection from the sun.

The West- End in Port Hedland is a good example of offering shaded pedestrian footpaths and buildings frontages that address the street but their is still room for improvement

Throughout North Africa and the Middle East screens are used over streets to protect pedestrians from the sun - Marrakech

Circulation routes have been created as short-cuts into and around the town centre can be activated to create conveniently located outdoor cafes - Broome

Countries with hot climates, such as Morocco, traditionally use colonnades along town centre streets to protect pedestrians and shop fronts from the sun. The width and height will need to be considered within the context of the town

Building on the PILBARA CHARACTER & IDENTITY

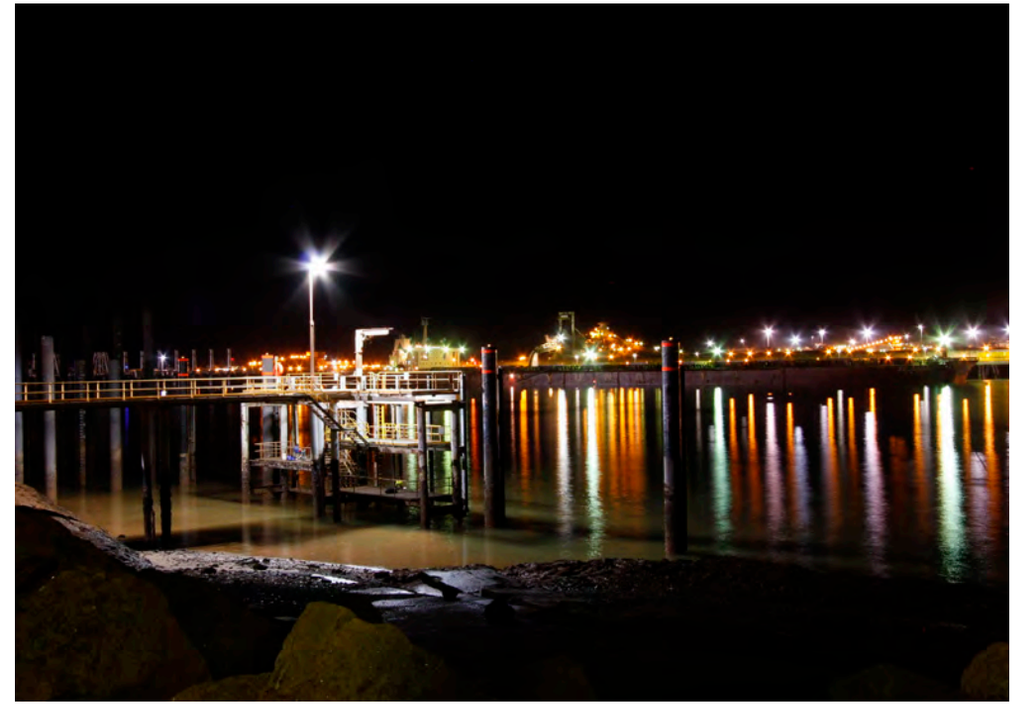
PRINCIPLE: IDENTIFY OPPORTUNITIES FOR TOURISM

Pilbara towns have relied on large industry, namely mining and drilling, to fund public works improvements. Development of tourism in the region would diversify income generating opportunities for towns and ensure long term financial sustainability and independence. It would also provide a broader range of employment options which, in turn, entices people to stay in the place.

The natural environment of the Pilbara offers unique experiences for tourists. The challenge is to make these experiences more accessible and to provide a high standard of support services and facilities.

Public Realm

- Respond to the needs of various tourist market groups. Enable a layering of tourism accommodation from backpacker hostels, serviced apartments and family chalets through to resorts.
- Encourage developers to invest in short stay accommodation such as resorts, at prime tourist spots.
- Plan for infrastructure and marketing at a regional level as well as for individual towns as destinations.
- Provide infrastructure which enables tourism operators to offer efficient and financially viable services, such as improving waterfront access, mooring and refueling facilities.
- Use tourism as a key driver in reactivation of town centres by identifying tourism support services, such as food and beverage, taxis, tour companies and travel agents.
- Identify key sites for tourism development and use these sites as major attractions to the town and region. Dampier and Onslow have prime waterfront real estate which is underdeveloped but provides potent marketing opportunities for developers and hospitality industry operators.



Port Hedland Harbour in the evening

The water and islands off Dampier offer fishing, boating and water activities for tourists.

The caravan park at Onslow is on a prime location overlooking the ocean.

Enhancing LIVABILITY

PRINCIPLE: ENSURE OPEN SPACE DIVERSITY

In order to enhance the livability of Pilbara towns, it is critical that public open spaces and amenities be maintained and enhanced. Development should consider how these spaces can contribute to the social life of the town, ensuring that they respond appropriately to the unique needs and values of the local community.

Public Realm

- Encourage residents to take guardianship of existing recreational spaces through strategies such as Adopt a Park.
- Implement maintenance programmes which make the spaces more attractive to residents.
- Consider the recreational activities which are popular with local residents and provide public spaces for popular activities to suit these, such as motocross sports, BMX, fishing, picnicking, skateboarding.
- Identify opportunities where public spaces can add to the biodiversity of the town as well as contribute to the social and recreational life of the community.
- Extend the usable hours of parks and recreation areas by installing lighting. This is particularly relevant in the Pilbara when it is often more comfortable to undertake physical activities in the evening when it is cooler.
- Share open spaces by responding to the varying needs of different resident groups at different times. For example, during the day, parents with young children could use a space for play and walking, and the elderly could use the space for meeting friends and passive activities. The same area could then be used by children after school and teenagers might use the space on weekends or at night.

One park needs to offer a range of amenities to cater for a wide variety of people. This park offers playground for families, a turfed area for informal sport, seating away from the activities for viewing the water, barbecue facilities for a gathering and lighting to access the park in the evening - Port Hedland

Skate parks are a popular activity for youth and the young at heart, lighting makes it accessible in the cooler hours and doubles as a meeting place - Newman

Off road access to popular fishing spots need to be maintained - Port Hedland

Enhancing LIVABILITY

PRINCIPLE: INCORPORATE ACCESS TO PUBLIC OPEN SPACE

As places grow, people need to benefit from this growth through proximity and easy access to significant public open space and the surrounding natural landscape. In hotter months, outside activity can occur during the cooler evening if facilities and infrastructure are designed appropriately. In the day, paths that are shaded and destination points which have refreshment facilities such as shade structures, shaded seating and taps, will improve accessibility.

Public Realm

CREATE ACCESS

- Review the town's footpath network. Identify how this can be extended and identify gaps between key destinations to strengthen pedestrian connectivity. Look at unofficial paths which have been created by local people taking the shortest or most convenient route. Consider incorporating these into the town footpath network.
- Ensure there are direct routes for pedestrians between residential areas and the civic centre, commercial zones and parks.
- Design movement networks for pedestrians which shorten walking distances and reduce time spent in the sun on hot days.
- Consider a dual network with separate routes for pedestrians which can be shaded and more direct, such as passing between buildings and across public open spaces.
- Ensure public transport from residential areas accesses parks and public open spaces.
- Encourage cycling as an alternative to car transport by including bicycle access in all road works projects and bicycle parking facilities at key destinations, such as retail zones and recreation facilities.

Direct routes to the town centre, schools and other necessary amenities will encourage people to walk and cycle - South Hedland

The boardwalk at Onslow is a popular connection from the town to Four Mile Beach, following the coastline.

Accessible concrete pathway in Newman

Enhancing LIVABILITY

PRINCIPLE: INCORPORATE ACCESS TO PUBLIC OPEN SPACE

Public Realm

USER COMFORT

- Upgrade existing pathways so they are comfortable for pedestrians. Plant wide canopy trees along the edges of pathways for shade.
- Consider easy access for all people to open spaces, including mobility impaired, the elderly, children cycling to school and people without cars.
- Design pathways which have sufficient width for cyclists and pedestrians.
- Maintain and reinforce visual access to open space and maximise views to significant landscape elements to give a sense of open space and connection to the local and regional environment.
- Ensure good lighting to paths and open spaces so that they can be used in the evening when high outdoor temperatures ease.

Wide footpaths can be shared by pedestrians, cyclists and parents with prams - Port Hedland

Open spaces make connections to the water - Port Hedland

Solar powered street lights - Port Hedland

Lighting popular public spaces such as at skate parks encourages all ages to utilise the space during the evening - Exmouth

Enhancing LIVABILITY

PRINCIPLE: DEVELOP OUTDOOR MEETING PLACES

As places grow, more outdoor places need to be created; this can be achieved either through creating new places or investing in existing places with more specific infrastructure. People need areas to socialise and connect with their community and the Pilbara climate is perfect for meeting outside in an informal setting, especially in the early morning or evening when temperatures are cooler.

Public Realm

- Incorporate outdoor meeting places into the town centre, subdivision and public open space planning.
- Due to the hot climate, ensure outdoor places provide extensive shade coverage.
- Locate and orient public spaces to take advantage of cooling breeze
- Provide infrastructure to support community gatherings as well as more intimate gatherings for friends and family, such as taps, electrical outlets, picnic tables and benches, barbecues, informal seating.
- Design to a human scale. Ensure outdoor meeting place are not over-scaled and result in an uninviting impersonal large space that may only be used for special events and gatherings.
- Design spaces for evening activities, when hot daytime temperatures ease and people come outdoors for relief from the build up of heated interiors. This will also encouraging local social connections.
- Consider lighting in outdoor areas so these spaces can be used safely at night. Use Crime Prevention Through Environmental Design (CPTED) principles.
- Design public open space shelters, picnic tables and seating to provide protection from the sun. Use trees for shade and orient on an east-west axis to minimise exposure to sun.
- Design shelters so that hot air is not trapped beneath the roof. Use permeable materials or separate the roof from solid upright panels.

Small pocket parks are intimate in scale and inviting for small groups or individuals to relax in - Port Hedland

Outside areas within the town centre need to be adequately shaded to encourage people to sit outside - Exmouth

The upkeep of the communal garden at Onslow is shared by local residents

Enhancing LIVABILITY

PRINCIPLE: DESIGN FOR WATER

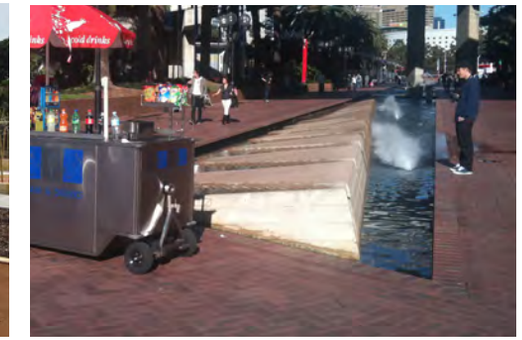
Water is a defining element of life the Pilbara. Availability is limited for many communities and low, erratic rainfall is characteristic of the region. Successful urban spaces must consider strategies to manage water use and consider methods of conserving water in the dry season as well as collecting and draining water in the wet season.

Public Realm

- Consider Water Sensitive Urban Design opportunities specific to areas where rainfall is over a short but intense period.
- Plan landscaping for all public realm areas using hydrozone principles to group vegetation according to different types of water requirements, thus making use of water more effective.
- Incorporate water features, such as ponds, fountains and streams into landscape design. Even in hot arid climates where rainfall is minimal, water can be recycled and used to cool public spaces.
- Adopt region specific water sensitive urban design strategies for public open spaces and buildings. Local councils need to make these available to all residents, planners and developers by posting information on strategies and examples on their websites. For example, Karratha has introduced a grey and black water collection system which processes and stores the town's effluent so it can be used to irrigate public landscape. This practice has been so successful that the shire is currently upgrading the system.
- Cover garden beds and planters with bark or stone mulch and compost to reduce water loss through evaporation and controls weeds whilst adding nutrients to the soil.
- Use ground covers rather than turf for areas which are not used for active recreation activities.

Water in the pubic realm can be effective in very small amounts, this water feature needs someone to physically pump the water to enable the water to flow through the created creek bed - Perth

Turf free public park - Perth



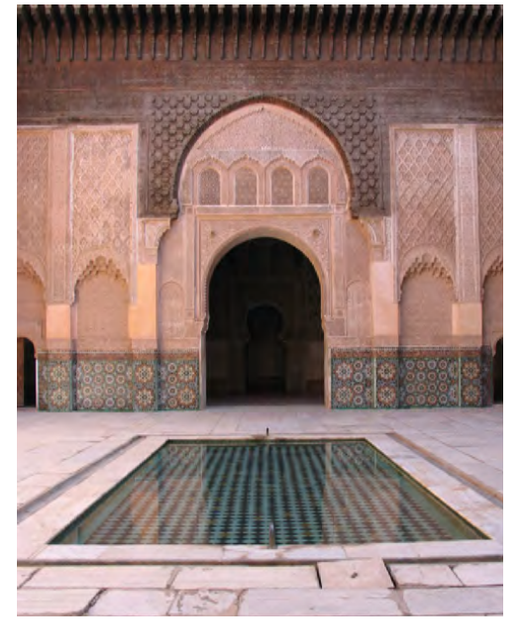
Water feature in public space - Sydney

Enhancing LIVABILITY

PRINCIPLE: DESIGN FOR WATER

Public Realm

- Use local native vegetation to reduce reliance on water, encourage a habitat for birds insects and contribute to evoking a sense of place for the town.
- Use drip irrigation to reduce water consumption.
- Acknowledge the cyclone season and respond with appropriate elements to deal with heavy deluges of rain, such as wide, deep street gutters and diverting stormwater to prevent soil erosion around from retaining walls and fence footings.



In the Middle East and North Africa, water is often used to cool transitional spaces such as courtyards and building entrances, even in areas where rainfall is low - Marrakech

Swales along residential streets in Dampier deal with heavy stormwater deluges as well as extending the usable outdoor space of adjoining lots

Culverts pass under roads - Port Hedland

Swales are a dominate feature in the landscape - Port Hedland

Enhancing LIVABILITY

PRINCIPLE: DESIGN FOR WATER

Numerous conservation strategies can be employed by homeowners to ensure a more sustainable and responsible use of water. At the same time, water can be used efficiently and effectively as a cooling feature.

Housing and Built Form

- Conserve precious water. Recycling grey water can be an efficient way to water a garden. Non-storage systems feed water from the laundry, kitchen and bathroom (not toilets) through a filter directly to garden reticulation. Rainwater storage tanks are helpful but limited in their usefulness because of the short spells of rainfall in the Pilbara.
- Water storage tanks are helpful but limited in their usefulness because of the short spells of rainfall in the Pilbara.
- Group plants in similar watering zones to reduce water usage.
- Use drip irrigation to reduce water consumption.
- Use ponds, fountains and water channels in the garden for a cooling effect. These features use a small amount of water if the water is recycled so water is but can be refreshing both psychologically and physically.
- Cover garden beds and planters with bark or natural mulch and compost to reduce water loss through evaporation and controls weeds whilst adding nutrients to the soil.

In ground gutters channel stormwater away from the building at the Pilbara TAFE campus - South Hedland

Mulch garden areas with stone or bark (avoid using in termite areas) - Port Hedland

Covered private swimming pools are a luxury worth investing in when living in the Pilbara - Dampier

Enhancing LIVABILITY

PRINCIPLE: DIVERSIFY THE BUILT ENVIRONMENT

A range of densities and building scales gives legibility to a town, helping to create a more vibrant built environment. This results in a more interesting urban experience for the town's residents, as well as the fly-in fly-out workers, short stay visitors and tourists who frequent the Pilbara towns.

Public Realm

- Ensure any planning proposals respond to demand and provide appropriate accommodation options for the local market.
- Focus on maintaining openness and permeability in planning.
- Review existing zoning policies and access their relevance to a town's plans for growth. Apply diversity at all scales from town centre to the residential street, whilst maintaining a comfortable human scale.
- In areas set aside for new housing subdivisions consider a range of zoning to provide a mix of accommodation options. This will provide variety of streetscape as well as people living in the area.
- In town centres, review zoning which restricts commercial development and is preventing land with obsolete or disused buildings from being developed. Diversity at all scales, whilst maintaining a comfortable human scale, will add vitality and variety to the town centre.
- Use 3D modelling to assess the form, scale and diversity of buildings and their impact on the street and adjoining buildings and open spaces.

Medium density multiple housing development that offers the choice of short stay or permanent accommodation near the town centre - Broome

Introducing passive design elements (wind scoops) into commercial buildings contributes to the identity of the town - Broome

Enhancing LIVABILITY

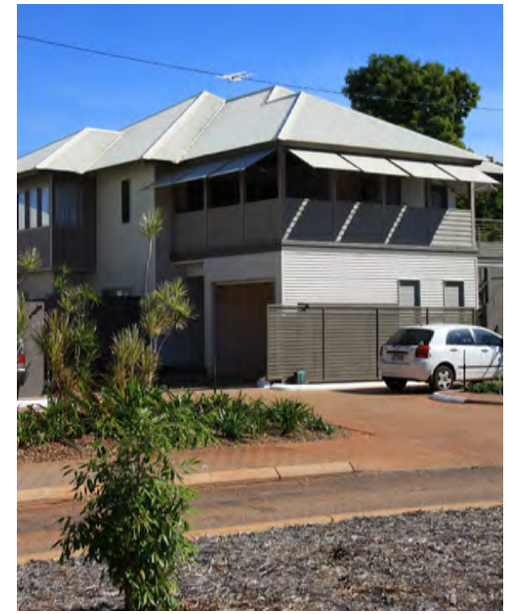
PRINCIPLE: DIVERSIFY BUILT ENVIRONMENT

Many towns in the Pilbara feature a narrow range of low to medium density housing, with single-storey detached dwellings as the dominant housing type. Encouraging more diversity in the built environment will provide more appropriate housing options for a wider demographic of Pilbara residents.

Housing and Built Form

- Encourage smaller, well designed houses to reduce building costs. This will make homes in a subdivision priced to attract a wider market.
- Broaden the demographics of the home buyers being catered for in subdivisions and offer a range of housing types, small to large, low to higher density, affordable and premium designs.
- Design for the residents. Consider and respond to their lifestyle, their ways of dealing with the hot climate, their use of outdoor space, their need for quiet bedrooms. Provide a range of houses which cater for different resident needs.
- Use 3D modelling to review house designs in the context of neighbouring houses.

Large first floor verandahs in a Broome group development



First floor verandah with shutters for shading and ventilation and cyclone security - Broome

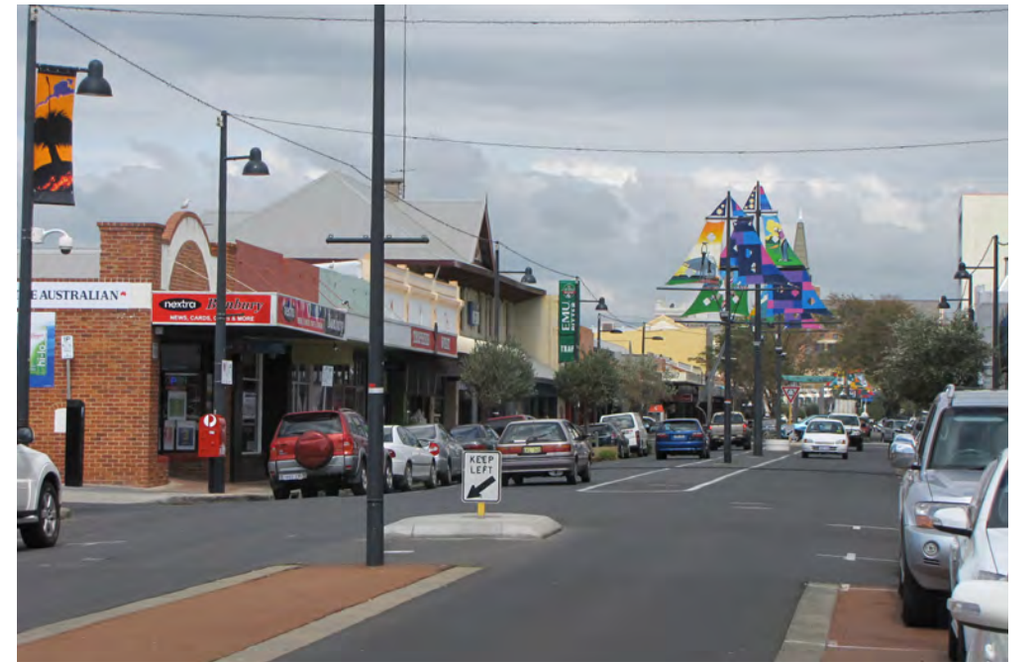
Mobilising for CHANGE

PRINCIPLE: FOCUS ON TOWN CENTRE VITALITY

Strategies that consider ways to support movement and activity within the region's harsh climate can be used to enhance the vibrancy of town centres in the Pilbara.

Public Realm

- Utilise evening time when the climate is cooler, consider reviewing the Spanish lifestyle to look for applicable easy to implement lifestyle strategies that enhance living in a hot climate. This could involve late opening and closing times and closure over the hottest part of the day.
- Ensure the town centre is well lit.
- Orientate any new town centre streets east west if possible with retail east facing side (afternoon shaded) and commercial (less intense pedestrian activity) on the west.
- Encourage service entries to be in rear lanes to reduce interruption and conflict with pedestrians and provide a continual streetscape design.
- Plan planting which is compatible with signage and lighting obstructing signage once maturity is achieved.
- Awnings are critical in this environment; Consider retrofitting awnings to ensure the town centre offer continuous protection from both sun and rain.



Bunbury's main street has undergone significant revitalisation over a number of years

Reviewing Exmouth and other similar towns that are more advanced in their revitalisation will help ascertain the qualities and design decision that may be applied to Onslow and Dampier

Mobilising for CHANGE

PRINCIPLE: FOCUS ON LOCAL ECONOMIES

Mining companies will continue to be the major source of employment and the key drivers of the local economy in the Pilbara. Often, the mining companies have been responsible for establishing settlements to provide accommodation and services for their workers. However, if the Pilbara towns are to have a healthy local economy in the future, we need to look at more community focused development which draws on a wider cross section of business opportunities. This will enable towns to offer more variety and choice to residents and visitors.

Public Realm

- Think local when planning and designing. Large companies reach out to a global market. Towns can stay focused on the local market and support local business operators by providing retail and commercial premises which are affordable and appropriate to their needs.
- Offer opportunities for local land ownership in commercial zones. Review existing zoning policies to enable lots to be used for more economical accommodation. Encouraging local business owners to purchase premises can protect them from outside factors which impact on their viability such as increases in rent.
- Investigate spaces for alternative commercial opportunities to those currently available especially to activate the edges of a town centre.
- Co-locating community services in commercial and retail areas can help stimulate trade and offer more convenience to customers.
- Allow for spaces which can be used for street markets to sell local produce and goods.
- Provide information about local manufacturers and producers on shire websites.

Markets in the park - Kununurra

Local retail business - South Hedland

Street markets traditionally provide an opportunity for local producers to sell their wares. - Tangiers

Mobilising for CHANGE

PRINCIPLE: CREATE AFFORDABLE HOUSING

The isolation and limited availability of housing in the Pilbara is reflected in the high cost of building, purchasing and renting homes in the region. In order to cater for lower income residents, a greater diversity of housing types must be considered. To reduce construction costs, consideration should also be given to sourcing materials and labour in more cost effective ways.

Houses which are designed and constructed to provide passive cooling will help reduce the reliance on mechanical cooling prevalent in the Pilbara. This could greatly reduce the energy costs of households, resulting in more affordable living conditions.

Housing and Built Form

- Encourage smaller but well designed houses to reduce the higher than average building cost.
- Offer lots that facilitate cardinal orientation to maximise passive cooling and reduce cost of living household expenses.
- Design appropriately for the region so that building systems and materials are used efficiently to keep housing costs controlled.
- Use simple building designs and systems, including using more pre-fabricated components.
- Maximise passive design principles to reduce reliance on artificial cooling, which will reduce household living expenses.
- To promote market acceptance of new design initiatives, build demonstration display houses in new subdivisions. Work with local councils to promote these.
- On site, minimise cutting to reduce wastage. Minimise finishing surfaces to reduce excess use of materials. Recycle debris.
- Consider providing service worker accommodation specifically the housing construction industry to keep the mobilisation costs of outside workforce down and reduce demand off the private rental market.
- Increase land supply to put downward pressure on rental and capital housing value.
- Encourage grouped and multiple residential accommodation for people who are on their own or are not in a financial position to purchase a freestanding house on a single lot.

Contemporary example of wind scoops - Broome

This house has a combination of elements that would reduce electrical usage - a solar hot water unit and operable windows to release hot air from the interior

Transportable prefabricated houses are viewed as an affordable option. Improved design will ensure the aesthetics, finish and operating costs are equivalent to an on-site build

Solar hot water units are a common sight in the Pilbara and other solar energy technologies would provide efficient power source for housing and commercial developments

Designing a house to reduce reliance on mechanical cooling needs to be addressed in each house design

Solar panels provide efficient power source for housing and commercial developments

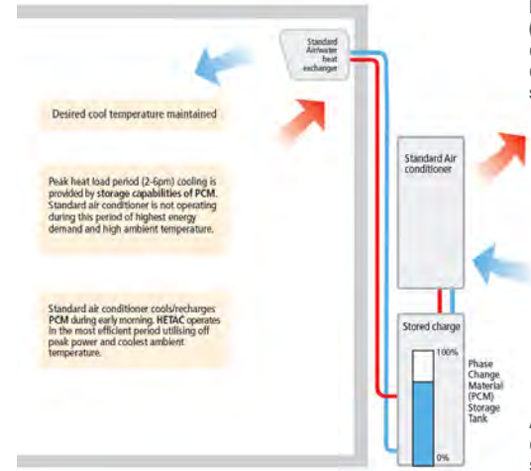
Mobilising for CHANGE

PRINCIPLE: INTEGRATE NEW TECHNOLOGIES

It is important to consider the role new technologies can play in addressing the unique challenges of the Pilbara. Developments in climate responsive technology are particularly relevant to building in this region.

Housing and Built Form

- Photovoltaic energy systems are particularly appropriate to use in the Pilbara because of the large number of days of sunshine. A photovoltaic system can power all electrical requirements in a building, alternatively, use solar energy for hot water heating only. Local and state government need to offer incentives for solar energy use to offset the high cost of transporting panels from Perth.
- Stay in touch with new building technologies. Developments in materials which help control thermal comfort is one area where new ideas are being actively tested. Low emissivity glass has become available in recent years and is continuing to be refined and improved.
- Allow for new communications technology in housing design. The isolation of towns in the Pilbara mean that wireless communications are especially important to residents to enable them to stay in touch with the rest of the world.



Heat exchange storage systems using Phase Change Materials (PCMs) can significantly reduce energy cost for interior cooling. Heat exchange systems are particularly effective for cooling in areas with a high diurnal temperature range. HETAC system shown

Advances in solar technology need to be utilised in the Pilbara, especially in areas that have a high number of clear sky days, such as Newman (below)