Port Hedland
AREA PLANNING STUDY

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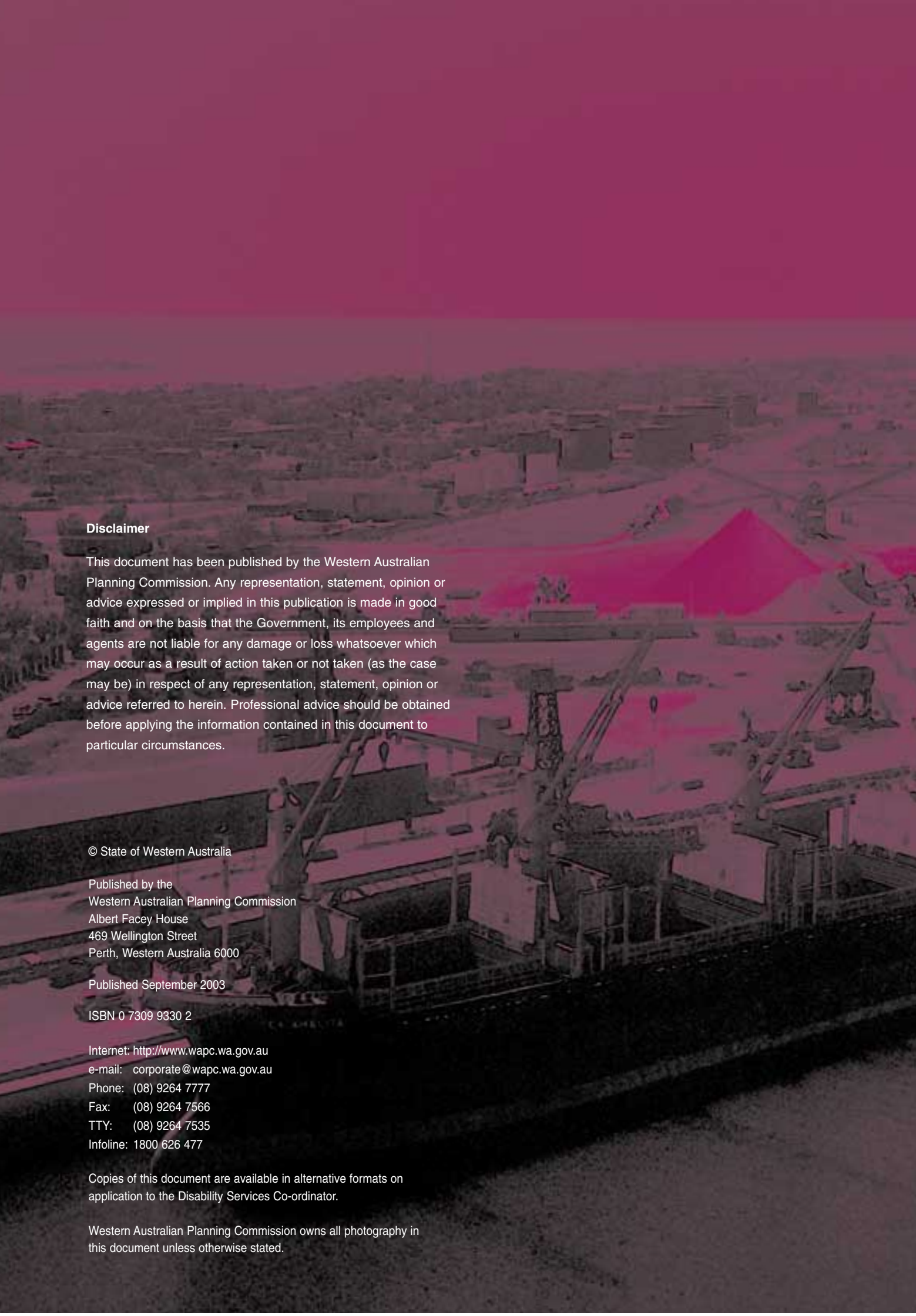

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Foreword

Port Hedland is one of the Pilbara's most historic and colourful towns. The townsite as we know it was established by European settlers in 1896 as a service centre for the pastoral, goldmining and pearling industries, although the area has been home to Aboriginal people for many thousands of years.

In the 1960s Port Hedland experienced a major growth period, as a direct result of the emerging iron ore industry. Port Hedland is now one of the largest iron ore shipping ports in the world. As well as the iron ore industry, Port Hedland is home to a WA's newest downstream processing industry, BHP's Hot Briquetted Iron Project as well as a large-scale solar salt operation. The port of Port Hedland also exports minerals such as manganese, copper concentrate and feldspar sourced from the east Pilbara. Live cattle export has recently emerged as a growing export industry in the town.

Despite its reputation as an industrial centre, the Port Hedland area has some significant environmental values, such as turtle nesting at Munda Beach, the wetlands of the De Grey River, and mangrove communities throughout the coastal zone. The Hedland area is also important to Aboriginal people who wish to maintain strong cultural and heritage links to the land and ensure that Hedland will be a good place future generations.

The $2 billion Hot Briquetted Iron plant and future establishment of the proposed Boodarie Strategic Industrial Estate will further cement Port Hedland as a major economic centre in Western Australia. Possible expansion of the Port Hedland harbour will also cater for economic growth in the area.

While mineral resources are an integral part of Port Hedland's economy, it is the Port Hedland community which makes the area memorable and full of vitality. It is important to attain a reasonable balance between economic, social and environmental factors in the future development of the Port Hedland area. Careful assessment of regional needs and community aspirations is necessary to maximise the benefits to the local community, and to the economy of Western Australia.

The plan identifies new land for urban development at Pretty Pool to accommodate approximately 1,000 dwellings and for infill development in the old Port Hedland area, which is possible due to the provision of deep sewerage.

The Port Hedland Area Planning Study was first released as a draft for public comment in 1998. Since that time a number of land use proposals outlined in the draft Study have been evaluated in light of the Greater Port Hedland Storm Surge Study, which was commissioned following the release of the draft Study. The Port Hedland Area Planning Study addresses all important regional issues and sets out a framework to guide State decision-making and detailed planning at the local level, with a planning horizon of 20-25 years.

Hon. Alannah MacTiernan, MLA
Minister for Planning and Infrastructure

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Summary of Recommendations

Environmental and Cultural

Principle from the State Planning Strategy

To protect and enhance the key natural and cultural assets of the State and deliver a high quality of life which is based on environmentally sustainable principles.

Issues in the Port Hedland area

- Areas with environmental values are not recognised and subject to misuse.
- Impacts of noise and dust from industrial operations at Nelson Point and Finucane Island.
- Access to Port Hedland harbour area by recreational boat users.
- Protection of coastal mangrove communities.
- Identification and protection of Aboriginal heritage and other sites in the context of other land uses.

WAPC policy

The WAPC will use its statutory land use decision-making powers and responsibilities to secure those natural and cultural assets of the study area for the enjoyment of future generations. In order to achieve this, it will seek the support and co-operation of other State Government agencies and in particular the Town of Port Hedland, as well as Aboriginal Communities, the private sector and residential landowners.

Actions to achieve policy position

- Reserve Munda Beach and Cowrie Creek as an environmental protection and recreation reserve, with joint vesting between CALM and the Town of Port Hedland. (**CALM/TPH**, DOLA)
- Review the Port Hedland Coastal Plan and widen the study area to include coastal area within the entire local government area and address access to coastal areas. (**TPH/DPI**, CALM, DEP, PDC)
- Support the implementation of guidelines for the protection of arid zone mangroves along the Pilbara coastline. (**DEP**, all agencies)
- Support Air Quality Monitoring program. (**DEP**)

Proposals requiring further investigation

- Investigate the environmental and conservation values and agricultural potential of the lower De Grey River, and make recommendations for its future use. (**CALM**, DEP, WRC, AGWA, TPH)
- Investigate reservation of Cemetery Beach, with joint vesting between CALM and the Town of Port Hedland. (**CALM/TPH**, DOLA)
- Devise appropriate management strategies to protect Aboriginal sites in the context of other surrounding land uses. (**DIA**, TPH, CALM, DPI)
- Identify additional areas for environmental protection and recreation with a view to subsequent reservation and management. (**CALM/DEP**)

Community

Principle from the State Planning Strategy

To respond to social changes and facilitate the creation of vibrant, safe and self-reliant communities.

Issues in the Port Hedland area

- Residents and tourists have difficulty accessing coastal areas, limiting recreation opportunities.
- There is a lack of suitable housing for Aboriginal people, particularly those visiting town.
- Housing and community services are put under pressure with rapid population increases associated with resources development.
- There is an ongoing need to improve townscape and amenity.
- The future aspiration of Aboriginal Communities.
- The Impact of cyclones, storm surge and flooding events.
- The adequacy of existing social services and future service needs.
- The impact of increased port activity on the local road network.

WAPC policy

The WAPC will encourage proposals and activities leading to the creation of attractive communities or enhancement of existing communities in the study area. This will apply to the major urban settlements of Port and South Hedland as well as individual Communities, the private sector and individual landowners.

Actions to achieve policy position

- Prepare an implementation plan for any outstanding projects as the South Hedland Enhancement Scheme winds up its activities. (**TPH**, PDC, DPI)
- Town of Port Hedland formally to endorse revised Townscape recommendations and implement accordingly. (**TPH**)
- Support preparation of Community Layout Plans for Aboriginal Communities. (**WAPC/DPI**, DIA)
- Support the preparation of the Storm Surge Emergency Management Plan. (**FESA**)

Proposals requiring further investigation

- Prepare a short-stay accommodation inventory detailing potential sites for accommodation camps and tourist accommodation and their status in terms of zoning, Native Title and capacity. (**DPI**, TPH)
- Prepare Social Impact Assessments for all strategic industrial developments, with release of an EPA Bulletin for the project as the catalyst. (**DPI/DIR/TPH**)
- Undertake a detailed analysis of future heavy vehicle transport movements for the greater Port Hedland area and identify possible network conflicts and options. (**MRWA**, DPI, DIR, TPH)
- Assess the proposed Boodarie Strategic Industrial Estate Buffer Zones in response to the State Industrial Buffer Policy and assess impacts on surrounding land uses. (**WAPC**, DEP, DIR, LandCorp)

Regional Development

Principle from the State Planning Strategy

To assist the development of regional Western Australia by taking account of the special assets and accommodating the individual requirements of each region.

Issues in the Port Hedland area

- Decisions affecting the region are often made outside the region, especially from Perth.
- There is a need to ensure co-ordinated actions from Government.

WAPC policy

The WAPC recognises the importance of the study area's economy to the creation of wealth in the State. This Study provides a means for the various arms of government can be co-ordinated through a locally based implementation mechanism, which is a principal aim of the Commission.

Actions to achieve policy position

- Establish a locally based regional co-ordinating committee to progress implementation of the Port Hedland Area Planning Study. (**WAPC/DPI**)
- Prioritise recommendations for implementation. (**Co-ordinating Committee**)
- Review the Study every five years. (**DPI**)

Infrastructure

Principle from the State Planning Strategy

To facilitate strategic development by making provision for efficient and equitable transport and public utilities.

Issues in the Port Hedland area

- The need to plan for efficient infrastructure corridors throughout the sub-region.
- The capacity of waste disposal facilities and location of new sites.

WAPC policy

WAPC recognises that the area relies on the provision of physical and social infrastructure for economic effectiveness and efficiency. The Commission will pay particular attention to the need to set aside and secure land for the provision of necessary infrastructure and service corridors.

Actions to achieve policy position

- Define infrastructure corridors for future linkages from the region into the greater Port Hedland area. (**DIR**, MRWA, PHPA, DPI)
- Protect infrastructure corridors through the Town of Port Hedland Town Planning Scheme. (**TPH**, WAPC)
- Locate future infrastructure in identified service corridors. (**all servicing agencies**)

Proposals requiring further investigation

- Identify landfill sites to cater for putrescible, inert and Class 4 waste and recycling. (**DEP/TPH**, DIR, LandCorp)

Economic

Principle from the State Planning Strategy

To actively assist in the creation of regional wealth, support the development of new industries and encourage economic activity in accordance with sustainable development principles.

Issues in the Port Hedland area

- Port Hedland has a narrow economic base.
- Port Hedland needs to secure basic raw materials (BRM) supplies and determine long-term supply options.
- There is uncertainty as to future commercial and industrial land supply.

WAPC policy

The WAPC will seek to ensure that the economic development of the area is able to flourish through the provision of available and suitable land for industrial and commercial activities. Additional economic activities designed to expand the area's economic base will be actively encouraged.

Actions to achieve policy position

- Ensure an adequate supply of commercial and light industrial land to support community and industrial development. (**TPH**, DOLA, LandCorp, WAPC)
- Advance horticulture project for Turner River precinct. (**AGWA**, WC)
- Maximise economic benefit from PHPA by allowing multi-user access. (**PHPA**, DPI)
- Support ongoing implementation of the Pilbara Economic Development Strategy. (**PDC**)

Proposals requiring further investigation

- Identify suitable marine and land-based sites for aquaculture and associated support facilities in support of the Pilbara Land Use Strategy. (**DoF**, CALM, DEP, DPI, PHPA, DIR)
- Prepare a tourism strategy for the Town of Port Hedland, identifying existing tourist products and infrastructure, possible tourist sites, development options and tourist markets. (**PDC**, CALM, AGWA, MRWA, WATC, DPI)
- Support the preparation of a development strategy and land use plan for the proposed expansion of the port of Port Hedland, including infrastructure corridors connecting to proposed Boodarie Strategic Industrial Estate. (**DIR/PHPA**, DEP, MRWA, DPI)
- Undertake a basic raw materials study in the Town of Port Hedland, identifying existing and future BRM sources and zone the land accordingly under the Town of Port Hedland Town Planning Scheme. (**TPH/DIR**, MRWA, WAPC)

Recommendations Arising from the Structure Plan

- Identify areas of natural heritage value within the Town of Port Hedland and minimise the potential impacts of development, sediment loading, surface run-off and erosion on these areas. (**TPH**, all agencies)
- Past planning for roads identified land for major roads and interchanges between Wedgefield and South Hedland, and the land was subsequently vested with MRWA. The vesting of the land should be investigated in the context of providing additional land for community or infrastructure purposes. (**TPH/MRWA**, DPI)
- Provision for an additional rail link from the east, south or west into the western side of the harbour should be investigated. (**PHPA/DIR**, MRWA, DPI, TPH)
- An area to the north (180ha) of North Circular Road has been identified as subject to further assessment. This land has been reserved for a variety of purposes, including a regional hospital, road reserves and infrastructure purposes, but is now somewhat of a “no man's land”. It appears to be surplus to existing and future needs and could be used for civic, cultural or recreational purposes although the eastern area may provide opportunities for further subdivision as larger-lot rural residential uses for equestrian purposes. Development of the land must occur in the context of a detailed land use plan. (**TPH**, DPI)
- Outline Development Plans (ODPs) are an essential part of implementing the Structure Plan and should be prepared for all areas marked as future residential. ODPs adopt the broad principles of the Structure Plan and take it to a further level of detail by outlining the road network, public open space, primary schools, neighbourhood shopping centres, public purpose sites and other major sites of interest. The area covered by the Structure Plan can be divided into a number of neighbourhood precincts. ODPs should be prepared in the Pretty Pool and Koombana areas as a matter of priority, then in other major residential areas as the need arises. (**TPH**, DOLA, DPI)


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Introduction

1.1 Need for the Study

From 1996-99, Port Hedland experienced a significant short-term growth phase associated with the progression of BHP's Hot Briquetted Iron Project and Capacity Expansion Project at Nelson Point. In the next 20-25 years, industrial development in and around Port Hedland may increase, largely as a result of expansion of existing industries as well as the deregulation in the energy industry which may provide greater incentive for downstream processing industries to locate in the area.

Provision has been made for additional industrial development through the identification of about 2,500ha of industrial land in the proposed Boodarie Strategic Industrial Estate, including a 2,000ha buffer. Major expansion of the port of Port Hedland to the western side of the harbour is also possible.

Provision must be made to accommodate emerging economic activities that will diversify the economic base of the Port Hedland area - these can include tourism, live cattle export, aquaculture and horticulture. Although the Port Hedland area is vast, there are a number of competing land uses in the area. It is the intent of this Study to identify and resolve land use conflict to assist regional development.

The State Planning Strategy and *Pilbara Land Use Strategy* (PLUS) offer strategic planning guidance at a State and regional level, and the local town planning scheme provides detailed statutory planning provisions. The *State Planning Strategy* and PLUS outline the need for sub-regional planning, especially in the growth pressure points such as Port Hedland.

In 1997, the need for sub-regional planning in the Port Hedland area was also acknowledged in the *Port Hedland Land Development Program*, which sets out anticipated land development proposals that require consideration by government planning and servicing agencies.

The above reports note the need for a strategic planning framework which details sub-regional planning needs and land uses, preferable townsite expansion areas and future infrastructure needs for a 20 to 25 - year period.

1.2 Major Issues Facing the Study Area

- Areas with environmental values are not recognised and subject to misuse.
- Protection of coastal mangrove communities.
- Impact of cyclones, flooding and storm surge events.
- Impacts of noise and dust from industrial operations and development sites.
- Residents and tourists have difficulty accessing coastal areas, limiting recreation and tourism opportunities.
- Housing and community services are put under pressure with rapid population increases associated with resources development.
- Ongoing need for improvements to townscape and amenity.
- Future aspirations of Aboriginal people living in the area.
- Identification and protection of Aboriginal heritage and other sites in the context of other land uses.
- Lack of suitable housing for Aboriginal people, particularly those visiting town.
- Adequacy of existing social services and future service needs.
- Port Hedland has a narrow economic base.
- Port Hedland needs to secure basic raw materials (BRM) supplies and determine long-term supply options.
- Uncertainty as to future commercial and industrial land supply.
- Planning for efficient infrastructure corridors throughout the sub-region.
- Impact of increased port activity on the local road network.
- Decisions affecting the region are often made outside the region, especially from Perth.
- Need to ensure co-ordinated actions from government.

1.3 Purpose and Scope of the Study

This Study has a future outlook of 20-25 years. The purpose of the Study is to undertake detailed planning in accordance with the *State Planning Strategy* and *Pilbara Land Use Strategy* by:

- ensuring that all current and future land uses are accommodated in an equitable manner;
- planning for future infrastructure;
- identifying preferable townsite expansion areas;
- improving town amenity and promoting regional identity on an ongoing basis;
- identifying areas of high environmental value;
- providing direction for development control and protection of the environment; and
- providing sound natural reserve management, particularly for coastal areas.

The study area is nominally the Town of Port Hedland administrative boundary, as indicated on Map 1, which includes offshore islands. However, the Study incorporates linkages to the adjoining local governments of Roebourne and East Pilbara, principally through the existing and future transport network. The Study focuses on Port Hedland which is the administrative centre for the East Pilbara and exports the bulk of the sub-region's resource output.

The report has two main components - a sub-regional plan and a Port Hedland Structure Plan. The sub-regional plan focuses on regional issues, such as environmental protection and recreation nodes, economic development and regional infrastructure. The Port Hedland Structure Plan outlines the status of existing services and land uses and indicates land use allocations to accommodate development in the townsite area.

The Port Hedland Structure Plan area is bounded by the coastline and offshore islands, the proposed Boodarie Strategic Industrial Estate, 9 Mile Creek and the area to the south of the existing South Hedland townsite.

A number of reports and projects have been undertaken in recent years on the Port Hedland area. This Study has synthesised much of the information contained in these reports. A list of current and complete Port Hedland projects is included as Appendix A.

1.4 Study Outcomes

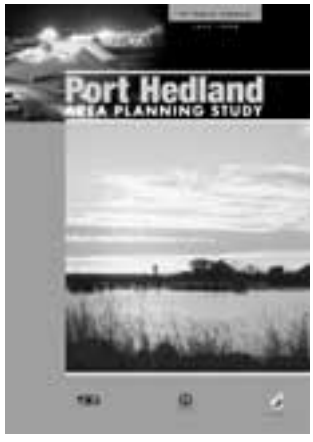
The projected outcomes of this Study are to:

- provide a long-term strategy and proposed land and water use plan to accommodate growth and development in the Town of Port Hedland;
- prepare a structure plan for the future urban expansion of Port and South Hedland and provide a basis for the planning and provision of infrastructure;
- provide guidance for the development of the Town of Port Hedland to support economic and social development; and
- identify gaps in current information and make recommendations for appropriate studies to be undertaken.

1.5 Consultation

The draft Port Hedland Area Planning Study was released for public comment in July 1998. Consultation had taken place with major public and private landholders and service providers prior to release of the draft. A list of people and organisations consulted is included as Appendix B,

During the public comment period, two public information sessions were held in Port and South Hedland. The public comment period was also extended until December 1999. Seventeen submissions were received on the draft Port Hedland Area Planning Study. A list of people and organisations who made submissions is included as Appendix B.

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2.0 Planning Context

2.1 Commonwealth and State Government Policies

Patterns of activity and development are affected by global, national and State influences and associated policies, agreements and legislation. A number of Commonwealth Government policies seek to influence the land use and development of the area. Areas of interest include landcare, the coast, the environment, oil/gas territorial waters, fringe benefits tax and Native Title.

The State Government considers land use planning systems and procedures in Western Australia as primarily State and local government matters but has co-operated in some joint projects with the Commonwealth Government. Current key State Government policies, policy documents under preparation and agreements include:

- *BHP Steel Industry Agreement Act 1952*
- *Iron Ore Beneficiation Agreement Act 1996*
- *Iron Ore - Direct Reduced Iron (BHP) Agreement Act 1996*
- *Iron Ore Processing (BHP Minerals) Agreement Act 1994*
- *Leslie Solar Salt Industry Agreement Act 1966*
- *Pilbara Energy Project Agreement Act 1994*
- *New Horizons in Marine Management* (WA Government)
- *State Planning Strategy* (WAPC)
- Conservation Through Reserves Committee recommendations to EPA
- *State Industrial Buffer Policy* (WAPC)
- *The Way Ahead - Maritime Transport Directions for Western Australia* (DOT)
- *A Nature Based Tourism Strategy (Draft)* (Western Australian Tourism Commission and Department of Conservation and Land Management)
- *A Background Paper for a State Heavy Industry Policy* (Dover Consultants)

2.2 Land Use Planning Systems in Western Australia

There are three levels of land use planning in Western Australia: State, regional and local. All levels take into account social, economic and environmental factors and how they are dealt with by other government agencies. The relationship between the levels and the components of each is illustrated by the following diagram:

State Planning Strategy
State Planning Policies State Development Policies Resource Management Policies Conservation Policies
Regional Planning Strategies
Regional Strategy/Plans State Management Plans Resource Development and Economic Plans Environmental Protection Policies Statutory Region Schemes
Local Plans and Strategies
Town Planning Schemes Land Use Plans Structure Plans Improvement Plans Development Plans Environmental Management Plans

Figure 1- **Land Use Planning Hierarchy**

2.2.1 Pilbara 21 (1992)

In 1992, State Cabinet endorsed *Pilbara 21*, which developed a number of recommendations for the Pilbara Region and Port Hedland area into the 21st century. The key recommendations were:

- the formation of the Pilbara Development Commission (PDC) to oversee the implementation of strategies;
- to promote the tourism potential of the Pilbara Region;
- to focus employment, education and training on the needs of industry in the region;

- for relevant government departments to provide a service and dedicated focus to the Pilbara Region;
- the promotion of a new phase in social development characterised by good planning, local management and coordination of services; and
- preparation of the Pilbara Land Use Planning Strategy based on the principle of multiple land use.

2.2.2 Pilbara Economic Development Strategy (1996)

The *Pilbara Economic Development Strategy* was released by the Pilbara Development Commission in 1996 as part of a Regional Development Council initiative. The time frame of the strategy is to 2010, and generally supports the recommendations of *Pilbara 21*.

The aim of the economic development strategy is to achieve a less mobile, and increasing population. The strategy outlines nine major objectives, with a number of strategies outlined under each objective:

- diversify the economy;
- create opportunities for Aboriginal people;
- remove impediments to development;
- normalise housing;
- improve and enhance service provision of education, health and other social issues;
- improve the general public perception of the Pilbara;
- exploit the Pilbara's competitive advantage;
- advocate multiple land use in the Pilbara based on the principles of ecologically sustainable development; and
- improve infrastructure.

2.2.3 State Planning Strategy (1997)

The *State Planning Strategy* was released by the State Government in December 1997 and provides a regional strategic planning and development framework. The strategy outlines scenarios for the State's development based on certain levels of regional economic development.

The strategy outlines a vision for the Pilbara Region:

> *"In the next three decades the Pilbara Region will be a world-leading resource development area focusing on mineral extraction, petroleum exploration and production and the primary stages of downstream processing. The region's population will grow in the future, fuelled by specific resource development projects, the sustainable development of Karratha and Port Hedland and a more diverse economy. A growing tourism industry will have developed based on the region's unique natural environment."*

To achieve this vision the strategy identifies a number of regional strategies:

- protect sensitive environmental and heritage areas;
- provide co-ordination of government agencies to minimise the delaying of resource developments and associated infrastructure needs;
- give greater emphasis to local recruitment and training of the workforce;
- promote opportunities for economic development;
- minimise the detrimental effect of fly-in/fly-out resource development projects;
- provide strategic transport linkages within and to the Pilbara Region;
- improve access to water supplies for domestic and industrial use;
- ensure infrastructure provision is the focus of appropriate government agencies;
- address the need for social facilities; and
- improve town amenity.

The strategy also identifies a number of planning strategies for the Pilbara Region. Those that relate to the Port Hedland area are:

- endorse the *Pilbara Land Use Strategy* as the framework for regional development needs in the Pilbara. (WAPC, PDC)
- maintain and update the Country Land Development Program for the Karratha/Dampier and Port Hedland areas. (WAPC)
- co-ordinate the provision of regional infrastructure in the areas identified for development under the Country Land Development Programs. (WAPC)
- prepare an Area Development Strategy for Port Hedland. (WAPC, PDC, LG).

The PHAPS is not designed to address the actions that relate to fly-in/fly-out projects, increasing the level of resource royalty income returned to the region and local training and recruitment of the workforce. However, for all other recommendations, the Port Hedland Area Planning Study is able to progress the regional actions, either directly, as in the case of preparing a Port Hedland Structure Plan, or in identifying mechanisms to promote the actions outlined in the *State Planning Strategy*. The *State Planning Strategy* outlines broad land uses throughout the State. The proposals which relate to Port Hedland are shown on Map 2.

2.2.4 Pilbara Land Use Strategy (1997)

The *Pilbara Land Use Strategy* (PLUS) is a regional land use strategy intended to guide the future development of the region based on principles of multiple land use and ecologically sustainable development, while providing a framework for more detailed plans. Preparation of PLUS was in response to a recommendation in *Pilbara 21*.

The strategy proposes a wide-ranging set of objectives and strategies relating to land use, with some of the proposed strategies having budget implications for government agencies. In preparation of the strategy, it was recognised that there is a relative scarcity of information about the Pilbara's land resources, particularly in regard to the environment.


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3.0 Regional Resources, Trends and Planning Implications

3.1 Social and Demographic

Social and demographic considerations are an integral part of the Port Hedland Area Planning Study. The following section provides an overview of the existing situation in Port Hedland, while examining some factors that will affect the lifestyle and opportunities of the Port Hedland community.

It should be noted that it is very difficult to provide accurate population projections and trends in an area like Port Hedland. The area's unique economy, being influenced by the world economy and workforce requirements, may give rise to significant variations in population projections. A major new industry in the area could boost population numbers, especially in the construction phase. Rapid population growth may compromise the ability of the various servicing authorities to respond to changes in demand.

3.1.1 Townsite Development

Port Hedland was gazetted as a townsite on 22 October 1896, and in its early years of operation was a service centre for the pastoral, goldmining and pearling industries. Until World War I, Port Hedland had a population 800 - 1,000 people. However, by 1946 only 150 people lived in the area.

The discovery of large iron ore deposits in the Pilbara and the lifting of the Commonwealth embargo on iron ore exports in 1962 gave rise to the formation of the Mt Goldsworthy Joint Venture and the Mt Newman Mining Co Ltd, which were to have a great affect on the fortunes of Port Hedland. The first shipment of iron ore from the Pilbara occurred in June 1966 from Finucane Island.

Associated with the development of the iron ore industry was the dredging of the harbour, construction of railway lines to Goldsworthy and Mt Newman, and the construction of housing and facilities to accommodate iron ore workers and their families.

Since then, the port of Port Hedland has become prosperous, shipping more than 65 million tonnes of iron ore per annum. In addition to iron ore, the port exports salt, manganese, feldspar, copper concentrate and live cattle.

With the rapid of expansion of Port Hedland, it became evident that the forecast population could not be accommodated in the port town. A new site was chosen about 14km south of Port Hedland.

South Hedland was established in 1966 as a response to growing pressure on Port Hedland. The town was based on the Radburn style of development which promoted a walkable living environment, with houses facing onto open space areas and being linked by walkways. This resulted in a highly convoluted road network that was inconvenient, for motorists and pedestrians. The extreme climatic conditions of the region made this subdivision design highly unsuitable and resulted in a low-quality visual environment and well-documented social problems.

3.1.2 State Demographic Trends

The population of Western Australia has been growing at about 2.5 per cent per annum in recent years. The *State Planning Strategy* outlines projections for the State and all of the regions based on natural increases, overseas migration and interstate migration. Three projections were used - low, medium and high series - with the medium being the most likely expected future population levels. It forecasts that the Pilbara Region is expected to register a sustained growth from 46,500 people in 1991 to 53,500 by 2021. These projections do not take into account the possibility of rapid increases or decreases in population which may occur as a result of changes in the mining industry.

3.1.3 Demographic Trends in the Town of Port Hedland

The population of the Town of Port Hedland at the 2001 Census was 12,776. Table 1 shows Census counts for the Town of Port Hedland from 1971 to 2001, and projections for the years 2006 to 2011.

The medium-level projections indicate that the Town of Port Hedland's population could grow to 15,100 by 2011. This projection is based on previous growth rates as well as future resource developments. These figures were based on trend data up to 1996.

Year	Census Counts for Townsite Only	LG Estimated Resident Population (ERP)	LG Population Projection (medium series)
1971	7,229		
1976	11,144	11,720	
1981	12,948	13,370	
1986	13,069	13,320	
1991	11,344	12,516	
1996	12,846	12,281	
2001	12,776	12,615	
2006			14,400
2011			15,100

Table 1 - Census Counts, Estimated Resident Population and Population Projections for the Port Hedland Townsite and Local Government Area

The Town of Port Hedland has a relatively young population with a strong bias towards young families. This is supported by the high percentage of people in the 25-44 and 0-14 age groups. The percentage of people aged over 65 in Port Hedland is lower than the WA average, due largely to the high cost of living in the area and the lack of services and facilities for elderly people.

Port Hedland is a multicultural town with nearly 30 per cent of all residents born overseas. The main countries of origin include United Kingdom, New Zealand, Yugoslavia, the Philippines and Singapore. Almost 15 per cent of people living in the Town of Port Hedland are Aboriginal, compared with a WA average of 2.6 per cent.

3.1.4 Service Population

The issue of service population is of particular relevance to Port Hedland due to the recent population influx associated with the construction of the HBI plant.

Since the 1996 Census of Population and Housing, there was a substantial population build-up which reflects issues raised in a 1996 Australian Bureau of Statistics discussion paper, When ERPs Aren't Enough - A Discussion of Issues Associated with Service Population Estimation. The discussion paper highlights the difficulty of when, how often and the cost of collecting Census data to reflect the service population accurately.

The population of Port Hedland is 12,776 based on the 2001 Census. One figure that is not reflected in the Census counts is the peak population of 18,000, which occurred during the HBI Project construction phase.

The sudden influx of construction workers in Port Hedland placed enormous pressure on the accommodation resources of the town, and on some community services such as medical and dental care. While many sectors of the community benefited from the economic boom of the HBI Project construction phase, it is fair to say that the Port Hedland community was generally unprepared for the social impacts of the project. It would be beneficial for Social Impact Assessments to be prepared for future strategic industrial developments, so that all sectors of the community may be able to prepare for the positive and negative impacts of large-scale industrial development.

3.1.5 Special Development Precincts

The Town of Port Hedland has a limited number of special development sites offering lifestyle choices, including South Hedland Rural Estate (Bosna Lodge), 12 Mile, Turner River and Redbank Bridge. The 12 Mile site has approximately 20 lots available only for the stabling and paddocking of horses - no development is permitted on these lots as there is no water supply. To date, only two or three of these lots have been used. The Redbank Bridge site has approximately eight lots available for rural residential development, with potential to develop up to 19, depending on demand.

In 1997, the WAPC approved a subdivision application for land at Turner River, south of the Great Northern Highway. The proposal subdivided a 20ha site into 18 lots of approximately 1ha. This has effectively established the Turner River as a development node, however at the time of writing very few of the lots have been developed. The South Hedland Rural Estate (Bosna Lodge) was approved in June 1998 and construction of the subdivision commenced in November 1999. Heavy rains and flooding occurred on the site in early 2000 and it is likely that further investigation will be required to ensure that appropriate flood mitigation approaches are in place to protect estate residents.

Wedgefield is also acknowledged as a special development precinct, as over time, a significant residential population has established in the area. While an increase in the level of residential development in Wedgefield is not supported, the Wedgefield community is a distinct cultural entity. Wedgefield's role in the development of the Port Hedland area is important, recently for accommodating the vast number of people unable to find suitable accommodation during the HBI Project.

3.1.6 Land Supply

The majority of future residential, commercial and industrial development in the Port Hedland area is to occur on Unallocated Crown Land (UCL) and may be subject to clearance of potential claims under the *Native Title Act 1993*. Compliance with the statutory provisions of the Act has the potential to extend the development process. The State Government is a major landholder in South Hedland, with a range of residential and commercial land.

Residential and Workforce Accommodation

The issue of land supply dominated planning in the Port Hedland area during 1996 as a result of BHP's construction of a HBI plant and the Nelson Point Capacity Expansion Project. However, analysis of land supply and demand undertaken by the Department for Planning and Infrastructure for the Port Hedland Land Development Program indicates that capacity exists to create residential lots well in excess of anticipated demand.

Short-term land requirements for the anticipated population increase were expected in the order of:

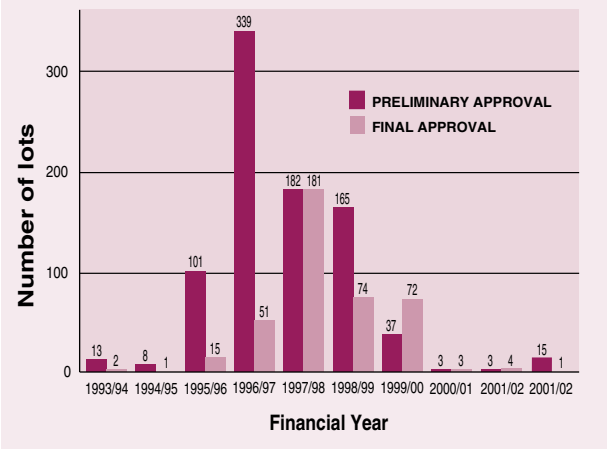
- 130 lots for BHP; and
- 50 lots p.a. for Homeswest and private sector housing investment.

A further 300 lots may have been required in 1999/2000, for Stage 2 of the HBI Project, but this did not eventuate.

Scope exists to create approximately 280 residential infill lots within and between existing communities in South Hedland. Potential exists to create a further 680 lots predominantly in Koombana before any new broadacre releases are developed that require major new roads, sewer catchments or schools. A portion of these latter lots will be created on proposed high school sites that are now surplus to requirement. A number of other short to medium-term opportunities were also identified in the coastal Port Hedland area.

In order to accommodate the needs of future industrial projects, it is important that sites be identified for a range of accommodation styles, including permanent long-term accommodation, short-stay accommodation such as Single Persons Quarters and chalets, and motel units.

Figure 2 shows that there has been considerable variation in lot creation in Port Hedland over the past years. The number of lot approvals in the first six months of the 1996/97 year was 300 per cent greater than the 1995/96 year. Lot creation has dropped off significantly since the end of the construction period for the HBI Project. Figure 2 refers to all lots created as a result of residential, commercial and industrial subdivision.



Source: Department for Planning and Infrastructure

Figure 2 - Lot Approvals - Town of Port Hedland 1993-2000

Industrial

The issue of industrial land supply in Port Hedland is complex. Wedgefield was established as a general industry area and permitted the establishment of caretakers' dwellings. General industry, by definition, supports a wide range of industrial land uses, ranging from showrooms and warehouses, to noxious or polluting industries which must be licensed by the DEP. However, in the eyes of the Port Hedland community, Wedgefield is an industrial area that supports a considerable residential population. As such, there are some general industry uses which are considered incompatible with the Wedgefield area from the residents' point of view, however, the primary function of Wedgefield is industry, so care must be taken to ensure that the residential land uses do not constrain the operation and development of legitimate industrial operations.

The issue for Wedgefield and Port Hedland is that there is no land available in the short term to support either a designated area for general industry (with no caretakers' dwellings) or an area for light industry, which would support caretakers' dwellings.

The Town of Port Hedland is undertaking further investigations in the area of industrial land supply so that a suitable mix of industrial operations can be established.

Commercial and Town Centre

There is considerable scope for additional commercial land supply in the South Hedland town centre. Most of this land is owned by the State Government. Additional land for service commercial activities includes the Byass and Nairn Street subdivisions, to the east of the South Hedland town centre.

There is limited potential for commercial development in Port Hedland, though it is considered that the Wedge and Edgar Street areas can accommodate a considerable amount of infill development to meet demand. The focus for commercial development is likely to be in South Hedland as this area accommodates a greater proportion of the current Port Hedland population, and will accommodate the majority of future townsite growth.

3.1.7 Housing

Although there is an adequate supply of land in the Port Hedland area, there is a possibility of a housing shortage, particularly as many new residents arriving during the construction phase of new projects are provided with subsidised housing by their employers and have very little incentive to build their own homes.

Those residents not provided with subsidised housing usually require low-cost rental accommodation, traditionally provided by Homeswest. This was highlighted by BHP's announcement to construct a HBI plant, which resulted in a spillover from the housing market to local caravan parks and transit villages. Therefore, mechanisms to encourage development of a more robust private housing market should be investigated.

The high cost of housing construction and population mobility limit private housing investment. While there has been a recent increase in private sector housing investment, clearly the reluctance of residents to be involved in land development adds to the uncertainty of demand.

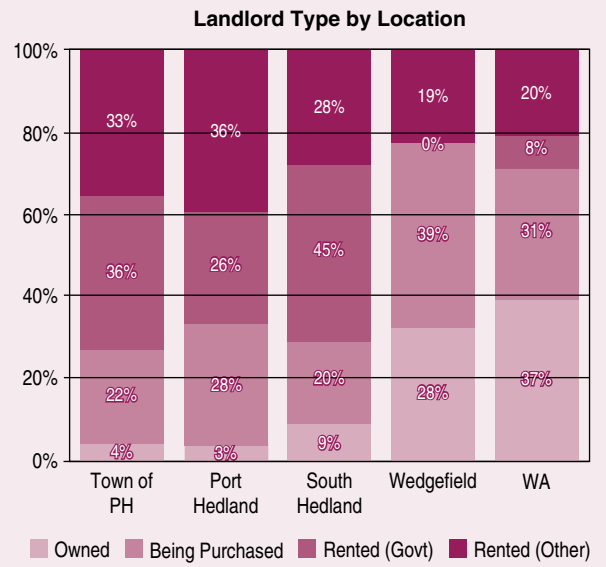
In October 1997, the Pilbara Development Commission (PDC) undertook a survey to determine the cost of housing in the Pilbara compared with Perth. Using figures provided by the Real Estate Institute of Western Australia (REIWA), and local real estate agents in the Pilbara, a table of median housing prices was compiled in index form, using Perth as the index figure of 100.0. The results are shown in Table 2.

These results show clearly that the HBI Project had a great effect on housing prices in Port Hedland, where the cost of renting a 3brm home in the Port Hedland area was more than 300% greater than the cost of a similar home in Perth. It should also be noted that the purchase price of homes did not increase as much as the rental price, indicating that demand was for short-term housing. There is a need to explore a greater range of accommodation options for workforces associated with strategic industrial development, particularly for people not directly employed by the project.

Figure 3 illustrates that housing tenure in the Port Hedland area is markedly different from the rest of the State. Few residents own or are purchasing their homes, while there is a high percentage of households renting homes from the Government. This can be attributed to the higher that average proportion of Homeswest housing in the area, and the provision of Government Employees' Housing Authority (GEHA) housing. It should also be noted that Wedgefield is the only area in Port Hedland where the proportion of "owned" homes is comparable with the rest of the State.

Median Price ($)	Perth	Port Hedland	South Hedland	Karratha
3brm house purchase	100.0	147.7	97.4	125.3
3brm house rental	100.0	423.1	275.9	160.8
Land	100.0	135.0	69.0	89.0

Table 2 - 1997 Housing Price Survey



Source: Town of Port Hedland - A Social Profile, Hedland College Social Research Centre, 1996

Figure 3 - Town of Port Hedland - Landlord Type by Location

3.2 Heritage and Culture

3.2.1 Aboriginal Heritage

Aboriginal people have lived in the Pilbara Region for over 30,000 years. Distinct tribal groups cover most of the region and have a close understanding of, and relationship with the environment.

The Nyamal and Kariyarra tribes were known to gather in the Port Hedland area. Evidence of prior Aboriginal occupation ranges from shell middens, rock carvings and mythological or religious places. Mythological sites are often natural features such as rivers, hills and rock formations where people, animals and characters left traces of their journey across the landscape.

Other sites, such as religious and ceremonial "increase" sites take the form of rock or stone arrangements. This is where various ceremonies are conducted to "keep the land alive", known as thalus. The ceremonies are to ensure the continuation or proliferation of particular species of animals, plants and natural phenomena.

Thalu sites on the limestone ridge that runs alongside Wilson Street have been destroyed. It is suggested that some sites were for rainmaking and some were for increase of marine fauna such as turtles and fish. There are rock engravings present at Boodarie landing and 2 Mile.

A number of sites in the area are registered sites under the *Aboriginal Heritage Act 1972*. Some sites are also registered heritage places under the National Estate and the Heritage Council of WA. These are at Nelson Point (rock engravings), South West Creek area (rock engravings, middens and stone structures) and Tulleryanna Hill.

As is the case throughout the Pilbara, the number of sites registered under the *Aboriginal Heritage Act* in the Port Hedland is likely to represent a small fraction of the number of sites capable of registration under the legislation.

3.2.2 Recent Aboriginal History

The introduction of the Pastoral Award in 1968 led to large numbers of Aboriginal people having to leave their traditional lands which, with the arrival of Europeans in the 19th century, had been taken up as pastoral stations. Prior to the introduction of the award, many Aboriginal people were able to live on their traditional lands and retain strong cultural links, often through unpaid work on the pastoral stations. The award established minimum wages for people working on pastoral stations which meant that most pastoralists could no longer support Aboriginal families on the stations. While most Aboriginal people lived in inland areas, the Government established camps for displaced people in the coastal areas of Onslow and Roebourne. This separated people from their traditional lands and had a bad effect on cultural customs.

3.2.3 Aboriginal Communities in the Port Hedland Area

There are four Aboriginal Communities in the immediate vicinity of Port Hedland. They are Tjalka Boorda, Tjalka Wara, Ngarla Njamal and Jinparinya. Yandeyarra, Warralong and Strelley communities are a little more distant, but are quite large communities which use Port Hedland as a service centre. The population of the communities ranges from 20 to 250, but it varies from time to time, due to social and cultural events.

Tjalka Boorda and Tjalka Wara have regular provision of utility services, being connected to town water, sewerage and power supply. Table 3 provides a basic summary of Aboriginal Communities in the study area.

Most Aboriginal Communities are on Crown land and administration has rested with various agencies responsible for service delivery. This has resulted in an ad hoc approach to the delivery of services and has led to problems and difficulties within these communities. Examples include the inappropriate location of housing areas and sewerage systems and the inefficient and haphazard provision of services such as water and power. These issues highlight a lack of integrated land use and infrastructure planning.

In response to concerns over the health and safety of residents of these communities, a committee of chief executive officers of a number of government agencies agreed that the best solution was to bring the communities under the same controls and requirements as conventional settlements. This would include the need for planning.

Community	Dist. from Port Hedland	Water Supply	Sewerage System	Power Supply	Population (variation)
Tjalka Boorda (3 Mile)	2km	extension of town service	yes	extension of town service	108 (25)
Tjalka Wara (12 Mile)	15km	extension of town service	yes	extension of town service	90 (99)
Jinparinya	35km	bore water	no	no electricity	30 (25)
Ngarla Njamal	40km	extension of town service	yes	domestic generator	31 (49)

Source: Ngarda Ngarli Yandu Region Community Profile, Aboriginal Affairs Department, 1995.

Table 3 - Summary of Aboriginal Communities in the Study Area

3.2.4 Town Planning and Aboriginal Communities

In 2000, the WAPC released *Statement of Planning Policy No. 13, Planning for Aboriginal Communities*, a policy that provides a framework for the planning of large permanent Aboriginal Communities. The objectives of the policy are to improve the standard of living and quality of life of people living in Aboriginal Communities by:

- providing a framework to ensure that large permanent Aboriginal Communities are afforded a high level of service;
- ensuring that these communities and associated land uses are appropriately identified and zoned within town planning schemes;
- providing a mechanism that will enable the local government and the Western Australian Planning Commission to approve layout plans prepared for Aboriginal Communities; and
- providing a framework for negotiation and decision making between Aboriginal Communities and local government.

Community Layout Plans are similar to structure plans for housing estates and address housing layout, existing and likely future infrastructure requirements, services and facilities, open space and civic and community sites.

3.2.5 Implications of the Aboriginal Heritage Act 1972

The Aboriginal Heritage Act 1972 provides for the identification and protection of Aboriginal sites throughout Western Australia. There are thousands of registered sites in the Pilbara Region, particularly in areas that have been disturbed through urban or mining development. It is estimated that there is a similar number of sites in more remote or less travelled areas in the Pilbara.

The *Aboriginal Heritage Act* requires that management or research on Aboriginal sites be subject to permission under Section 18 from the Aboriginal Cultural Materials Committee, an advisory body to the Minister for Indigenous Affairs. Permission is usually conditional on the approval and involvement of the Aboriginal custodians of the site, and on the input of a professional heritage conservator.

Sometimes Aboriginal sites are also popular recreation or tourism sites. For example, coastal sand dunes used for beach access often contain cultural material or burial sites, and rock art sites are tourist attractions in their own right. This may lead to site damage, for instance by traffic and pedestrian impact, loss of vegetation, pollution, graffiti, or litter. In such cases, management may be required.

The involvement of Aboriginal people in the management of their heritage is very important. There is a need for sensitivity in the treatment of cultural material, which can often be ensured only by the involvement of a heritage consultant. Development of vacant land generally requires clearance under the *Aboriginal Heritage Act 1972*.

3.2.6 Implications of Native Title

The *Native Title Act 1993* provides for the recognition and protection of Aboriginal and Torres Strait Islander peoples' Native Title rights and interests. The Act provides a process to determine whether Native Title exists and protects the existing rights of governments, industry and the general public. The Act also provides ways to negotiate and enter into agreements regarding future public works and business activity on land or waters where Native Title rights and interests are affected.

Certain Government actions, such as grants of freehold or other exclusive tenures to other parties, have been found to extinguish Native Title. Claims for Native Title cannot be made over areas where Native Title has been extinguished, for example, land held by freehold or exclusive tenure in developed areas in Port Hedland. There has been a considerable degree of uncertainty regarding land supply in relation to the Act and this has affected many communities in the Pilbara Region. As an increasing number of determinations in regard to Native Title are made and indigenous land use agreements entered into, it is likely that certainty in land supply will be restored.

3.2.7 Built Heritage

In accordance with provisions of the *Heritage of Western Australia Act 1990*, the Town of Port Hedland has prepared a municipal inventory, which details sites and buildings with heritage value, although not necessarily registered by the Heritage Council of WA.

St Matthew's Anglican Church and Medical Staff Quarters are registered by the Heritage Council of WA, and the pastoral homesteads of Boodarie, De Grey and Mundabullangana have been nominated as having heritage value and are awaiting evaluation.

3.3 Physical Characteristics

3.3.1 Landforms

Much of the Pilbara Region is geologically very old and has been subject to erosion over a long period.

The Port Hedland area contains five broad landform units:

- coastal dunes
- coastal flats
- floodplains
- offshore islands
- the northern dissected plateau (the Pilbara Block)

The rivers crossing the coastal plain have extensive floodplains because of the nature of the relatively flat and featureless landform and the volume of water in times of peak flow. The volume of water corresponds with the pattern of rainfall in the region. The rivers are not permanent, and may be dry for more than a year depending on the pattern of rainfall.

3.3.2 Soils

The soils of the area are predominantly red, due to the presence of iron oxide. The rugged hills have skeletal loamy soils while the tributary plains have duplex soils which consist of sand overlaying clay. The floodplains, ancient lakes and areas with volcanic rocks have clay soils. The soils of the alluvial plains in the northern regions differ in terms of texture and lime content because of differences in the geology of the hinterland.

3.3.3 Vegetation

Vegetation in the Port Hedland area is sparse, and is mostly representative of semi-arid northern areas of the State. Shade is scarce, with the dominant vegetation communities being hummock grasslands.

The Pilbara Region has eight recognised botanical districts. Vegetation in the Port Hedland area is mainly characterised by the Dampier District, which features Pindan vegetation. This vegetation group includes a ground layer of spinifex, and other low shrubs and trees. Vegetation along the coastal strip consists mainly of mangroves.

The South Hedland area is also home to Pundul trees, which provide a distinctive natural feature in South Hedland.

3.3.4 Topography

The topography is generally flat, with occasional rocky outcrops, rising to 200m AHD above the coastal plain. Approaching Port Hedland from the south, Mundabullangana Station generally marks the “end of the rocky country”, and is attributed to the Aboriginal meaning of the word.

Map 3 indicates the broad physical characteristics of the study area.

3.3.5 Climate

The Port Hedland area is semi-arid characterised by high temperatures, low rainfall and high evaporation. The area is also subject to tropical cyclones between November and April, which can bring heavy rainfall. Table 4 shows average climate details for Port Hedland, compared with Perth and Karratha.

Table 4 shows that Port Hedland experiences higher levels of rainfall, but higher temperatures (and for longer periods) than Karratha, though Hedland is only 200 km north of Karratha. On average, the highest average rainfalls occur from January to March as a result of thunderstorms and cyclonic activity. Table 5 shows annual rainfall in

millimetres and illustrates the extreme variation in annual rainfall levels. The long-term average annual rainfall is 301 mm.

3.3.6 Flooding and Storm Surge

On average, two or three cyclones cross the northern coastline of Western Australia each year. During a cyclone, destructive winds of up to 200kmh are not uncommon. Heavy rainfall associated with some cyclones can result in widespread flooding that supports the local ecology by replenishing groundwater resources.

South West and South Creeks are the dominant natural watercourses that traverse and drain a significant catchment of approximately 73km^2 into the Port Hedland harbour. The catchment extends about 35km inland and rises to an elevation of 80m AHD. The catchment includes three substantial development nodes in the lower reaches: the proposed Boodarie Strategic Industrial Estate, the South Hedland townsite and Wedgefield. Although these creeks are dry for the majority of the time and the catchment small in the context of the major rivers within the study area, the impact of run-off from a cyclonic downpour is significant. Run-off is reduced by the Mt Newman Railway that excises a portion of the catchment immediately to the east of the line.

A subsequent drainage study of South West Creek was commissioned by BHP for the HBI Project in 1994. Public submissions to the Consultative Environmental Review raised concerns locally regarding the proposed construction of the HBI plant in the 1 in 100 year storm surge and rainfall run-off flood plains. The concerns extended to the possible flooding of South Hedland and Wedgefield due to the backwater effects of peak flood events being restricted by the Goldsworthy Railway. In a response outlined in *EPA Bulletin 784*, the EPA recommended environmental conditions requiring the proponent to liaise with the Water Corporation, Department of Transport and Department of Minerals and Energy on the detailed engineering design to ensure no adverse impacts result, including the effects of backwater flooding of South Hedland.

A further assessment was also made for LandCorp - Department of Resources Development in 1995 as part of the Boodarie Resource Processing Estate Environmental Report. This assessment assumed the eastern extent of the proposed Boodarie Estate abutting South West Creek would be filled above

	Mean Daily Maximum Temp (C)	Mean Daily Minimum Temp (C)	Median Rainfall (mm)	Days with temp >= 30 C
Perth Region	23.3	13.3	854.2	58
Karratha (Dampier Salt)	32.2	20.5	261.4	207
Port Hedland	33.1	19.2	309.5	261

Source: Bureau of Meteorology.

Table 4 - Climate Characteristics of Port Hedland, Perth and Karratha

Annual Rainfall (mm)	87	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Port Hedland	101	172	153	533	568	96	213	119	406	225	348	270	488	216	571

Source: Bureau of Meteorology

Table 5 - Port Hedland Annual Rainfall 1987-1999

the anticipated 100 year flood level. The impact of this assumption diverted flow further east into the proposed support industries area. The 1995 assessment did not include modelling the impact of changes to the South West Creek flow regime on the adjoining South Creek and flood levels for South Hedland. It is understood that BHP has undertaken some storm surge modelling for South Creek, but at the time of writing, this was unavailable.

Associated with cyclonic activity is the threat of storm surge. This occurs when low pressure systems associated with cyclones raise sea levels, and when accompanied by a high tide, result in significant inundation of low-lying coastal areas. This surge usually can be accommodated in the system of tidal creeks common to the area, although it is possible that more extreme events may affect urban areas of Port Hedland.

In 1998, the Ministry for Planning, the Town of Port Hedland and the Department of Resources Development commissioned the Greater Port Hedland Storm Surge Study into the combined effects of storm surge and rainwater flooding in the area from the Turner River to 12 Mile Creek. This study provided a series of maps showing the likelihood of inundation for 50 and 100 year return periods. The study methodology included three main components:

- the establishment of a detailed storm surge model over the region which allowed storm surge levels to be evaluated at a spatial resolution of 100 metres;
- the establishment of river catchment models for three primary river stream systems (Turner River, the combined South West and South Creek system, and Beebingarra Creek) and the specification of 50 and 100 year event design floods for each; and
- the integration of the two data sets to provide design flood levels over the region.

A primary outcome of this process was the delineation of the 100 year flood levels which is shown in Map 4.

The more important findings of the study were:

- The study confirms that storm surge represents the major risk to Port Hedland township itself as well as for Wedgefield which is partially flooded at 50 years and a little more extensively flooded at 100 years. Surge levels at 100 years are generally consistent with previous studies, but also show how predicted levels vary around the region due to the local topography.
- Flooding from water running into the South West/South Creek system appears only to threaten the south-west fringe of South Hedland with such events being unlikely to coincide directly with peak storm surge activity due to the lag between surge peak and the run-off peak. It is noted however, that the accuracy of this component of the study is limited in turn by the accuracy of the topographic data available to the Study Team.
- Beebingarra Creek is likely to flood significantly at 100 years (and to some extent at 50 years) as a result of rainfall run-off, but again the topographic data available for the area was not highly accurate. Nevertheless, the site of Tjalka Wara Aboriginal Community appears quite vulnerable to flooding arising from extreme rainfall events over the Beebingarra Creek catchment.
- While the Turner River is clearly vulnerable to major run-off events caused by extreme rainfall over the upstream catchment, the study shows that the mouth of the Turner is also particularly vulnerable to major storm surge.

The study findings have serious implications for land use planning in Port Hedland, particularly in the areas of town planning and emergency management.

Town Planning

The 1 in 100 year return period for surge and flood events is an accepted standard for assessing suitable locations for urban areas within a townsite. This sets an acceptable level of risk for property and infrastructure in a community and is widely used for insurance purposes in flood-prone areas. Matters are complicated if the 1 in 100 year risk areas are not known, particularly where a

townsite is already in existence, as is the case with Port Hedland. The results of the *Greater Port Hedland Storm Surge Study* will be incorporated in the Town of Port Hedland's Town Planning Scheme No. 5 and will form the basis of statutory requirements for land use and development in the study area. This may have the potential to affect the development potential of areas that are considered to be at risk from storm surge and flooding inundation.

Emergency Management

While a 1 in 100 year return period is an acceptable level of risk for town planning purposes, it does not guarantee the protection of urban areas for more extreme events, which may have return periods of 1 in 150 or 200 years or even greater. The likely extremity of a particular cyclonic event is calculated by the Bureau of Meteorology and it is then the responsibility of the appropriate emergency services personnel to determine factors such as alert categories, road closures, areas to evacuate and timing of evacuation.

3.3.7 Water Resources

The study area is covered by the Port Hedland (709) and De Grey (710) Drainage Basins as defined by the Australian Water Resources Council. The Pilbara Region has harsh climatic conditions and rainfall that is dependent on cyclonic and thunderstorm activity. As such, the river systems of the study area are dry for much of the year but have large floodplains that are a valuable source of groundwater when rainfall does occur.

Two major river systems flow across the coastal plain from the Chichester Range which rises steeply from 200-300m AHD to 400-500m AHD about 180km inland. These are the Yule River about 80km west of Port Hedland in the Port Hedland Basin and the De Grey River about 70km to the east. The De Grey has several major tributaries, including the Shaw, Coongan and Oakover which are classified as rivers in their own right and have significant potential yields.

Groundwater is currently extracted from wellfields located in water reserves on the Yule and De Grey Rivers. The water is pumped into Port Hedland for industrial and domestic use. Two other wellfields exist at Goldsworthy and Shay Gap to the east of the De Grey. The former is no longer in use but both are potentially available to augment existing sources.

The Water and Rivers Commission has prepared a comprehensive review of Pilbara water resources which are detailed in the *1996 Pilbara Region Water Resources Review and Development Plan*. The review sets out details of existing and potential sources of surface water and groundwater, existing demands and current entitlements and potential source development options to meet anticipated demand to 2025. These details are discussed subsequently in the context of infrastructure to support economic development.

The Water Corporation (WC) undertook the *Port Hedland Water Source Strategy* in September 1996. This study has a 50-year horizon and explored the findings of the WRC review in greater detail. The findings indicated that there were numerous groundwater resources in the Yule and De Grey River aquifers, capable of generating about 20-30GL in excess of current licensing.

The Port Hedland Water Source Strategy indicated there would be no need to establish dams to service the Port Hedland area, nor to use the West Canning Basin. Although initial planning has been undertaken for the extension of the Yule and De Grey aquifers, further research is required to prove supplies and refine costings.

The WC investigation established the cost of water source development as a benchmark to assess future supply options, which include desalination. Desalination is becoming more affordable through technological improvements and reduced energy costs, which include using waste heat from power generation.

A seawater desalination trial was undertaken in 1996/97 to compare two seawater desalination systems which used different pre-treatment methods followed by reverse osmosis desalination of seawater. Both desalination systems produced water suitable for drinking. The sponsor group for the project discontinued the trials after six months when there was a loss of membrane integrity in one of the pre-treatment membranes, and the cause of this loss could not be determined.

However, desalination remains an option for water supply once technologies are improved.

The Turner River Alluvium has been used to augment supplies for Port Hedland in the past, but the wellfield is no longer in operation. Potential remains for groundwater supplies from within the existing wellfield, although not identified in the *Water Resources Review*.

The Turner River area was identified as a potential horticultural area in a 1993 PDC study, The *Potential for Horticultural Development in the Pilbara, Western Australia*. The area would be reliant on the Turner River water resource, although allocation of the source cannot occur until the project is formally progressed.

Between 1998-99 the Water and Rivers Commission finalised a number of Water Source Protection Plans for water reserves in the Pilbara Region. In the Port Hedland area water source protection areas were established for the De Grey and Yule River water reserves, which extended the existing water source protection reserves. Areas adjacent to the De Grey and Yule River aquifers are now classified as Priority 1 water source protection areas. The Priority 1 classification recommends that land uses in the reserve be limited to protect the water source.

3.4 Environmental and Conservation Values

3.4.1 Turtle Nesting

Turtle nesting is an important conservation value in the North-West of the State generally, and there are two significant sites in the Port Hedland area - Munda Beach and Cemetery Beach. These are shown on Map 3.

Munda Beach is a significant nesting area for Flatback turtles, which are sea turtles found in Australian waters. Most turtles use offshore islands for nesting purposes. The Munda Beach rookery is one of the largest for the Flatback turtle in the State and data collected by CALM in a tagging exercise indicate that several hundred female turtles lay eggs at this site each year. The Flatback turtle is a threatened species under the *Wildlife Conservation Act 1950*.

The greatest threats to nesting turtles are foxes and human activity. Human activity can range from 4WD vehicles and lights disorientating nesting turtles to harvesting of turtle eggs. This is an area of land use conflict between recreation, conservation and pastoral uses.

Cemetery Beach in Port Hedland is also a Flatback turtle rookery, but nesting at this site is far less dense than at Munda Beach.

3.4.2 Munda Beach/Cowrie Cove

Cowrie Cove and Creek, adjacent to Munda Beach, also has conservation value in that it represents a mangrove community characteristic of the Pilbara coast. Besides being an important area for protection, Munda Beach is also a popular recreational area, being accessed by 4WD vehicles for boating, fishing, swimming and turtle watching.

Munda Beach forms part of the Mundabullangana pastoral lease, however the 40m strip between the pastoral lease boundary and the high water mark is Unallocated Crown Land (UCL).

The *Wilson Report* (1994) recommends that reservation of the beach and hinterland is urgently needed to protect the Flatback turtle rookery. It also suggests that the tidal waters of Cowrie Creek be included in this reserve. The proposal is to reserve the land for the purpose of public recreation and protection of flora and fauna.

3.4.3 De Grey River and Delta

The De Grey River is approximately 80km north-east of Port Hedland. It enters the sea at Breaker Inlet between Poissonnier Point and Larrey Point. In this vicinity there are extensive mud and sandbanks associated with the river delta.

The *State Planning Strategy* identifies the De Grey River as being a Strategic Terrestrial Environmental Amenity Area, and areas adjacent to the river are shown as Strategic Agricultural Areas, with potential for intensive/irrigated agriculture. Identification of the De Grey as an agricultural area could be a source of conflict in terms of water supply, in that the De Grey borefield is the major supplier of water to the Port Hedland area, for domestic and industrial use. Any detailed study of

the potential for horticulture on the De Grey River delta would require assessment of the quality and quantity of water available.

The De Grey River once featured extensive wetland areas, which have deteriorated in size and ecological integrity over the years. However, some large freshwater pools remain and the river system is considered to have significant conservation value. The wetlands of the De Grey River are considered to be of national importance and are listed in the Australian Nature Conservation Authority's *Directory of Important Wetlands in Australia*.

Given the environmental significance of the De Grey River, and the identification of the area as suitable for intensive agriculture/irrigation, there is a need for a detailed ecological investigation of the river, to establish possible areas with conservation value and to make recommendations on the future use of the river and surrounding areas.

The saltwater crocodile has been establishing itself in this river in recent years, which is considered by CALM to be a natural reclamation of the crocodile's traditional habitat. The De Grey River is considered the best crocodile habitat south of the Fitzroy River. At present, it is estimated that about half a dozen crocodiles have established a permanent presence in the Pilbara.

CALM has a Crocodile Management Plan which relates to the Pilbara Region. This manifests itself in signage along the De Grey River and semi-regular patrols to the site. Up to 12 sightings per year are reported in the Port Hedland area, although most are unconfirmed (i.e. not sighted by a CALM officer).

Crocodile control areas exist in within a 15km radius of Finucane Island. This means that any crocodiles found in the area will be caught and sent to a crocodile farm. In other areas, crocodiles are managed, rather than controlled. This means that they are allowed to remain in the area, and CALM erects crocodile warning signs.

3.4.4 Offshore Islands

There are several offshore islands in the Port Hedland area: North Turtle, Bedout, Downes, Weerdee, Ronsard and Reef. North Turtle Island is located about 20km north-west of Larrey Point and Bedout Island is approximately 40km north of Poissonnier Point. Both islands are important nesting sites for a range of seabirds and are Class A Nature Reserves.

Downes and Weerdee Islands are about 2km from the Port Hedland harbour area. These islands have moderate conservation value and have been recommended in the EPA's Conservation Through Reserves as being suitable for reservation. Downes Island has been recommended for inclusion in the CALM estate as a reserve for recreation, conservation and other purposes. Downes Island has significant intertidal areas, providing a habitat for wading birds, and also contains areas of Aboriginal significance and several species of mangrove particular to the Pilbara Region.

The waters around Downes Island are also home to an aquaculture operation and an aquaculture operation has been approved on the island itself. Given the level of development pressure on the Dampier Archipelago, it is possible that aquaculture operators may begin to consider Port Hedland as a suitable location.

3.4.5 Coastal Planning

A coastal management plan was prepared for the Town of Port Hedland by the then Department of Planning and Urban Development in 1992. The plan's focus is the Port Hedland townsite, from Oyster Point to 6 Mile Creek. It was released for a period of public comment, which did not result in any changes to the plan, and the draft document was subsequently endorsed by Council.

The *Port Hedland Coastal Plan* made 23 recommendations on coastal planning. In 1998, the Town of Port Hedland established a Coastal Planning and Management Committee. One of the key tasks for the committee was to examine the 1992 Coastal Plan and determine to what extent the recommendations had been addressed, as well as identifying other areas which required attention.

Commonwealth funding for Coastcare projects has been utilised by community groups in the Town of Port Hedland for several years, with a range of projects receiving assistance, including:

- dune stabilisation, beach access and walkway repairs & replacement, $48,700 (1995);
- Cemetery Beach dune stabilisation, beach access, walkway repairs & replacement construction $50,000 (1996);
- Interpretative program for the protection of flatback turtles $3,900 (1998); and
- Sutherland Street Cyclone Relief Funds $50,000 (incorporated with 1995 = $98,700)(1999).

Access to the coast in the Port Hedland area outside the townsite is primarily via pastoral stations. Conflict arises where fences are damaged, gates left open/or closed, or tracks are damaged. In addition, uncontrolled access to pastoral stations may present a quarantine risk, especially where tourist vehicles are involved. Pastoral stations accessed in order to gain coastal access are Mundabullangana, Boodarie, Pippingarra and De Grey. Access to pastoral stations is subject to a number of provisions outlined in the *Land Administration Act*.

The *Roads 2020 Regional Development Strategy* (MRWA, 1997) identifies a number of roads/routes that are subject to review. These include Yule River Access, Turner River Access and De Grey River Access, which could all provide access from the North West Coastal Highway to the coast. The need for these roads will be reviewed at intervals of five years. Their construction would minimise conflict between pastoralists and those seeking access to the coast, but could also provide an unacceptable level of exposure to sensitive coastal environments.

3.4.6 Mangroves

The Port Hedland area is home to several species of mangrove. Mangroves are plant formations which inhabit sheltered tropical and sub-tropical coastlines. They act as nursery, feeding and breeding grounds, and as buffer zones against wave action, thereby reducing erosion and storm surge damage to coastal areas. They are considered an integral part of coastal and marine processes.

In April 2001, the EPA released *Guidance Statement for Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline*. Four management areas were designated, with the following guidelines:

Guideline 1 Regionally significant mangroves located ***outside*** designated industrial areas and their associated port areas.

Guideline 2 Other mangrove areas located ***outside*** designated industrial areas and their associated port areas.

Guideline 3 Regionally significant mangroves located ***inside*** designated industrial areas and their associated port areas.

Guideline 4 Other mangrove areas located ***inside*** designated industrial areas and their associated port areas.

There is potential for land and water use conflict in management areas subject to Guideline 3. This is not the case for the Port Hedland townsite area, as no regionally significant mangrove stands have been identified in the guidelines. However, nearly all the coastline from Weerdee Island, west to the Yule River has been identified as containing regionally significant mangrove areas.

3.4.7 Air Quality

The Government has provided funding through the DEP to commence the development of air quality management plans for industrial estates in the Pilbara. In the Port Hedland area, this involves the Boodarie Strategic Industrial Estate. The components of the air quality management plan are expected to be:

- advice on relevant air quality standards;
- advice on air quality issues pertinent to industrial development within the particular estate;
- definition of buffer zones around and within the estate to limit the likelihood of unacceptable impacts;
- guidelines for siting of particular types of industry in relation to their air quality impact (e.g. ground-level odour omissions vs tall stacks), to optimise the use of the estate;
- comprehensive air quality and meteorological databases, assembled from existing databases and from monitoring programs undertaken for this purpose; and
- advice on, and provision of, a computer model for dispersion of industrial emissions at the site.

Funding for air quality monitoring has been provided to the DEP over a four-year period, commencing in the 1997/98 financial year. This is to be supplemented by meteorological and air quality data from industry, the Bureau of Meteorology, and DMPR/LandCorp. It is anticipated that the first two years of the program, in monitoring the selected industrial estates, will develop comprehensive air quality and meteorological databases.

In the Port Hedland area, BHP undertakes meteorological and air quality monitoring at the HBI plant on Boodarie Station and provides this data to the DEP on a monthly basis. This data will also be used by DMPR/LandCorp to establish a baseline air quality of the proposed Boodarie Strategic Industrial Estate.

The Air Quality study will model sea breezes to determine air circulation patterns. The outcome of the study will be an Environmental Protection Policy on Air Quality, which will be a legally binding document through the *Environmental Protection Act 1986*. This is similar to policies that have been established for the Kwinana Industrial Area, and for sulfur dioxide in Kalgoorlie. The outcomes of air quality modelling will be required by law to be incorporated in future land use plans.

In 1996, the EPA assessed a program by BHP Iron Ore to upgrade its dust management at Finucane Island and Nelson Point (*EPA Bulletin 831*). The proposed program has four main components to address the following key issues:

- impacts of airborne dust on community amenity;
- potential impacts of airborne dust on public health;
- potential ecological impacts of airborne dust; and
- potential impacts of wastes containing iron ore fines on the water quality and mangroves.

On the basis of information contained in BHP's dust management program and in the submissions received by the EPA, the main environmental factors relevant to the program are:

- airborne dust in relation to the health and amenity of Port Hedland residents;
- airborne dust in relation to the surrounding ecological values, particularly the health of mangroves; and
- wastes containing iron ore fines in relation to water quality and health of mangroves.

It was concluded that the dust management program can meet the EPA's objectives subject to the satisfactory implementation of the program, the proponent's commitments, and the conditions and procedures recommended by the EPA.

3.5 Natural Resource Management and Economic Development

3.5.1 Land Tenure

The Pilbara Region has a variety of land tenure arrangements, with most of the region covered by pastoral leases. Areas not covered by leases, National Parks, reserves, State Agreements and freehold ownership are Unallocated Crown Land (UCL). In the Port Hedland area, this includes land for urban expansion at Pretty Pool, Wedgefield and South Hedland. Competing uses for UCL include industry expansion, town expansion, environmental protection, recreation and tourism, and heritage.

The Land Administration Act 1997 came into effect in early 1998, and replaced the 1993 Act. The Act aimed to tidy a range of land administration matters, including:

- subdivision and development of Crown land;
- management, classification and amendment of reserves;
- classification and dedication of roads; and
- pastoral leases.

The introduction of the *Land Administration Act 1997* has a number of implications for the Pilbara Region, as it has a diverse and complex range of land tenure agreements compared with other areas of the State, and supports a range of tenures in a multiple-use setting. All these arrangements aim to meet the varied needs of pastoralists, the resources development industry, tourists, land management agencies, traditional land owners and public utility service providers.

The proclamation of the *Native Title Act* in 1993 generated considerable confusion and uncertainty in regard to land tenure in particular and land use planning in general. Until the interpretations of various aspects of the Act are clarified, it is difficult to suggest how to address the potential impacts on a range of existing land uses. This situation may be resolved as various Native Title agreements are reached between traditional owners and other groups. The principles of Native Title and their application may also be clarified as a body of common law accumulates to supplement any Commonwealth or State Government legislation.

There is a range of land tenure arrangements in the Port Hedland area. Most of the study area is covered by pastoral leases, with the old De Grey - Mullewa Stock Route and old North West Coastal Highway providing a link between the station homesteads.

Land tenure in the Town of Port Hedland is shown on Maps 5 and 6.

3.5.2 Natural Resource-Based Economic Activity

3.5.2.1 Pastoral Use

Pastoral use is the dominant land use in the study area, with seven pastoral stations in operation: Mundabullangana, Boodarie, Indee, Wallareenya, Pippingarra, Strelley and De Grey. Stations in the study area predominantly run cattle.

All pastoral leases expire in 2015, which has potential to have a considerable impact on land tenure arrangements in the State and also the Port Hedland area. The *Land Administration Act 1997* attempts to resolve a number of issues regarding leasehold titles. Part 7 of the Act acknowledges that Commonwealth legislation will not allow pastoral lessees to enjoy any more beneficial rights under their leases than they presently enjoy. Until the matter of granting perpetual leases is resolved, new pastoral leases in the new Act will be limited to a term no greater than that granted under the existing lease. This restriction, based on the provisions of the *Native Title Act 1993*, will result in extensions of leases for terms varying between 21 and 49 years.

Part 7 of the *Land Administration Act* covers the administration of pastoral leases and provides for the establishment of the Pastoral Lands Board which is required to place greater emphasis on land use, ecologically sustainable development, prevention of degradation, and rehabilitation of degraded and eroded rangelands. Pastoralists are required to manage their lease to its best advantage as a pastoral enterprise. It is essential that improvements are maintained and the Board

may require lessees to submit a development plan for the progressive achievement of improvements. Stock and improvement declarations must be submitted each financial year.

The Act also provides opportunities for enterprise diversification through a permit system. A lessee may apply for a permit for clearing, sowing of non-indigenous pastures, other agricultural uses and tourism. The permit is available only to the pastoral lessee and is not transferable. If an outside investor is sought for a diversification project, then the land must be excluded from the pastoral lease and a general purpose lease negotiated with DOLA.

3.5.2.2 Livestock Export

Livestock export from Port Hedland resumed during 1994 after a lull of 11 years. Table 6 presents details of recent cattle export activity through Port Hedland since 1993/94.

Year (financial)	Ships	Cattle	Weight (tonnes)	Tonnage variation (%)
1993/94	2	2,361	956	
1994/95	4	4,849	1,720	79.9%
1995/96	10	11,195	4,566	165.5%
1996/97	18	21,689	7,635	67.2%
1997/98	8	14,832	4,062	-46.8%
1998/99	16	28,772	10,737	164.3%
1999/00	19	31,807	11,801	9.9%
2000/01	27	63,610	18,991	62.1%
2001/02	16	47,687	15,404	18.9%

Source: PHPA

Table 6 - Live Cattle Export Figures, Port Hedland 1993-2000

An increase in potential export of up to 50,000 cattle p.a has been identified over the next five to eight years through changes in demand for specific breeds. Stock is exported mainly to Malaysia and Indonesia, however the Middle East is emerging as a strong market, taking larger loads of cattle than the South-East Asian markets. The PHPA has been active in pursuing the live cattle export trade, and has constructed a weighbridge and road configuration to assist.

Due to environmentally imposed sustainable stocking rates and uncertainty of regular seasonal rain in the Pilbara, Port Hedland's export activity draws on a catchment from Carnarvon to Meekatharra and east to Anna Plains. Threats to the potential of this growing trade are freight and loading rates from other ports around the WA coast.

Holding yards were established on the North West Coastal Highway in 1994, approximately 25km west of Port Hedland, to enable pastoralists coming to Port Hedland from all over the Pilbara Region to marshal their cattle in one place. Cattle can be loaded only during a six-hour period because of tidal conditions. The PHPA has commissioned a feasibility study into extending the No. 1 wharf to reduce berthing delays for cattle ships.

It is likely that there will be significant demand for port facilities if port expansion occurs to the western side of the harbour, and access for live cattle exports must be considered in the context of competing uses. In the event of major and sustained growth in the live cattle trade, consideration must also be given to demands on local resources and opportunities to establish other local economic activity such as horticulture to grow stockfeed.

The existing cattle holding yards are located immediately adjacent to the proposed Boodarie Strategic Industrial Estate, on land vested for the purpose of cattle holding. The yards take up only a fraction of the 225ha lease area and the lease area is crossed by easements for the Pilbara Energy Pty Ltd gas pipeline.

With the likely expansion of the live cattle export industry, there may be a need to upgrade significantly and expand cattle facilities in Port Hedland. This may involve the holding facilities, watering facilities, feed stock facilities, addition of on-site accommodation, addition of an office building, holding facilities for other animals such as goats and sheep and the inclusion of an abattoir or other spin-off industries.

Significant expansion and upgrades of the existing holding yards are likely to conflict directly with the industrial land use proposals in and around the current cattle-holding site. A new site adjacent to the Turner River, outside the proposed Boodarie Estate and buffer, and adjacent to the Turner River Aquifer, may present opportunities for expansion of the live cattle industry.

3.5.2.3 Agriculture

At present, there are no agriculture or horticulture projects in the Port Hedland area. In 1993, the PDC undertook a horticulture feasibility study, investigating three possible sites for horticulture use in the Pilbara. Land at the Turner River, to the north of the North West Coastal Highway was considered to be the most feasible. On the basis of the study, three sites of 40ha were chosen, located halfway between the Turner River borefield and the North West Coastal Highway. There is also some potential to develop another site to the south of the highway.

The horticulture project established that a water supply for the horticulture sites could be obtained from the Turner River borefield, with a licence issued by the Water and Rivers Commission. The lots have not been excised from the Boodarie Station pastoral lease to date. The De Grey River is also identified as a potential site for intensive agriculture/irrigation in the *State Planning Strategy*. Investigations into the impact of horticulture proposals on water supply for domestic, industry and environmental requirements should be undertaken.

3.5.2.4 Commercial Fishing

Fishers operating from Port Hedland operate to the north and north-east of the town up to 120N east longitude, or approximately to the mouth of the De Grey River. Port Hedland is used periodically as a fishing area, with fishers accessing port infrastructure for offloading. There is a lack of suitable infrastructure for fishers, which has tended to limit the number of operators fishing in the area.

A number of fishing activities are licensed in the Pilbara Region, which is defined as being from 114N east (Exmouth Gulf) to 120N east (De Grey River Mouth):

Fish Trapping - There are six licences in the Pilbara. Fishers are limited to 13 traps per vessel, and must fish outside the 30m depth contour line. Fish trapping is a limited entry fishery, although there are no limits to the catch and operating hours of fishers.

Wetline Fishing - In April 1997, the Minister for Fisheries announced a review of fishing limits for this industry in the Pilbara Region. Department of Fisheries is currently determining a benchmark figure to allow sustainable use of the resource. Part of this process will be to establish a suitable tonnage figure for wetline fishers, and will limit the number of operators in the Pilbara Region. At present there are 1,200 wetline licences throughout the State, with no restriction below the Exmouth Gulf as to where fishing can take place. Following the Minister's announcement in April, no applications are being accepted for new wetline licences in the region. The number of vessels permitted to operate in Pilbara waters will be limited, pending the determination of a suitable benchmark figure.

Fish Trawling - There are 10 licences for fish trawling in the Pilbara Region. Trawlers must fish outside the 50m contour, which is approximately 40 miles offshore. Fish trawling yields approximately 3,500 tonnes of fish per annum. In 2000 the fishery yielded 2,075 tonnes of finfish, and is considered a fully exploited resource. The Pilbara Trawl fishery is considered minor in the context of WA's other fisheries.

Prawn Trawling - There are 14 licences for prawn trawling in the Pilbara Region. Approximately six boats currently use the Port Hedland area. Prawn trawling is a limited entry fishery and fishers are restricted on the net length they can use. This industry yields approximately 110 tonnes per annum.

Use of the Port Hedland area for fishing and unloading varies on a periodical basis. However, it is estimated that there may be up to 18 vessels in the region at certain times of the year. This would typically include six prawn and fish trawlers, three wetline fishers and two or three visiting trap boats. Port Hedland is the only major port facility between Point Samson and Broome.

The provision of facilities for commercial and recreational fishers would assist in diversifying the local economy in terms of fishing and tourism, and provide more recreation opportunities for residents. However, it should be noted that most commercial fisheries in the Pilbara are limited entry and fishers are restricted in the amount of fish resources they may extract. Thus, the potential growth of the fishing industry is limited. In addition, infrastructure at John's Creek has been improved to assist commercial fishing vessels.

3.5.2.5 Recreational Fishing

Fishing from recreational craft is an important recreational pursuit for many Port Hedland residents, given that access to coastal areas by vehicle is extremely limited. Department of Fisheries estimates that there are about 2,000 recreational craft in the Port Hedland area. Two major boat-launching areas are provided in the Port Hedland townsite, at Finucane Island and adjacent to the port. The PHPA has constructed a fishing/small craft jetty, which permits commercial fishing boats access to a wharf when the commercial wharves are unavailable.

3.5.2.6 Aquaculture

There are currently two aquaculture leases in the Port Hedland area - a pearling lease between Weerdee and Downes Islands and a land-based hatchery for marine shells (including trochus and pearl oysters) on Downes Island. Given the demand for aquaculture leases in the Karratha area, it reasonable to suggest that operators may begin to consider Port Hedland as a suitable location for aquaculture enterprises.

Interest has been expressed in establishing aquaculture operations in some tidal creek areas, including 4 Mile Creek but these proposals have not progressed.

Trials have been conducted for a pilot beta carotene project within the Cargill Salt lease area. Beta carotene is a yellow-orange pigment produced by an algae, grown in land-based saline ponds. It is a naturally occurring chemical that can be used by the body to produce Vitamin A. Production of beta carotene has not progressed to market stage, but there is potential for this type of development to occur in or around the Port Hedland area.

The *Pilbara Land Use Strategy* recommends that detailed research be undertaken to prepare an aquaculture/mariculture development plan for the Pilbara Region in full consultation with, and agreement of, all interested parties. Until this development plan is prepared, appropriate sites cannot be identified in this land use planning Study.

3.5.2.7 Tourism

Tourism is viewed as a desirable economic activity in the Pilbara Region, and one with the potential to diversify an economy dominated by resources development. The majority of tourists in the Pilbara Region are self-drive tourists, who usually travel during the mild Pilbara winters. This trend is likely to continue in the next 20-25 years. Changes to the tourist market are dependent on the provision of tourism infrastructure such as sealed roads, resorts and airports, particularly in the tourist target areas of Karijini National Park and the Dampier Archipelago. Port Hedland is recognised as a ‘gateway’ in the Pilbara Region, especially for people travelling from Karijini National Park and Karratha to the Kimberley Region.

Tourist Infrastructure

Port Hedland has a range of tourism infrastructure to cater for a variety of tourists, with four caravan parks, five motels and a number of smaller accommodation providers, catering for backpackers and contractors. All the caravan parks have on-site chalets and caravans, as well as caravan and camping sites.

During the construction peak for the HBI Project, there was considerable pressure on local caravan parks to meet tourist demand. Each caravan park in Port Hedland designates a number of sites for

exclusive tourist use, and the Town of Port Hedland offers overflow sites in times of extreme need.

Tourist Features

The main tourist enterprise in the area is industry tours through BHP's Nelson Point port area. There is also a diving tour operation in Port Hedland, which offers guided dives to various shipwrecks and other marine features in the waters off the town. At present, there are few designated tourist and/or camping nodes, which has resulted in uncontrolled use of the coastal zone and inland waterways. Areas subject to use, which intensifies during the tourist season, include De Grey River, Cape Thouin, Coongan River, Mystery Landing and the Yule River.

During the mild winter months, Port Hedland hosts such activities as the Blackrock Stakes, Spinifex Spree and the winter horse-racing carnival. These events attract tourists from within the Pilbara, as well as those travelling in the region.

Tourist Activities

The Port Hedland area has great potential to develop tourism based on Aboriginal culture and heritage, particularly in the area of tours guided by Aboriginal people. Nature-based or ecotourism is also possible. Specific areas with potential for development of tourist product and infrastructure include:

- Munda Beach - turtle watching, fishing, swimming, boating, short-stay accommodation, station-based accommodation;
- Cemetery Beach - turtle watching;
- Offshore waters and maritime history - historic ship re-building and tours, whale watching and dive tours; and
- Station-based accommodation - using DeGrey-Mullewa Stock Route with travel from station to station.

Tourism Management

Besides the local Port Hedland Tourist Bureaus, based in Port Hedland and South Hedland, there are two peak bodies in the Pilbara Region which assist the tourism industry:

- The Western Australian Tourism Commission (WATC); and
- The Pilbara Tourism Association (PTA).

The WATC supports the development of tourism product and infrastructure to assist the tourism industry. This largely occurs through the Tourism Development Fund, which provides dollar-for-dollar funding to approved non-commercial projects. Examples include entry statements, board-walks and interpretive centres, though a range of products may be considered in the annual funding applications.

The PTA was established in 1996, with the key role of marketing and promoting existing tourist destinations in the Pilbara Region. The PTA is funded jointly by the WA Tourism Commission, resource companies, the four local governments in the region and the Department of Indigenous Affairs.

The *Pilbara Land Use Strategy* recommends the identification of suitable sites for the development of tourism infrastructure and product. This is strongly supported, given the lack of tourist product in the Port Hedland area.

3.5.2.8 Mineral and Energy Resources

There are no known major economic mineral deposits within the Port Hedland local government area, although iron ore and salt are stockpiled in and exported from Port Hedland. In addition, mineral producers in the Eastern Pilbara use the port of Port Hedland for the export of minerals such as manganese, copper concentrate and feldspar. There is also the prospect of other exports in the future. The following provides a brief summary, and indication of existing and future prospects of export materials from the port of Port Hedland:

Existing

- Manganese (Woodie Woodie) - long-term shipping capacity up to 300,000tpa. Total resources could amount to a seven to eight year life. Further exploration could extend life of project well beyond this time frame. Recent production has been approximately 100,000tpa. The company is examining the establishment of a possible manganese alloy plant at Port Hedland to produce 100,000tpa of manganese alloy.
- Copper Concentrate (Telfer) - Supply of 5,000-10,000tpa likely, but could be intermittent/unpredictable.
- Feldspar (Pippingarra) - Good demand for this product. Could have a output of 50 - 70,000tpa for up to 20 years.
- Copper (Nifty) - Currently exporting 9,000-12,000tpa, with product transported to Perth. Stage 2 is proposed to be phased in following the depletion of ores from the phase 1 project and will involve the treatment of primary ore to produce copper concentrate. Rates of output are estimated at 250,000tpa, with a mine life of 10-15 years. It is highly likely that the concentrate would be shipped from Port Hedland.

Proposed

- Copper (Maroochydore) - This project consists of a very large, very low-grade copper cobalt resource of 167Mt. If the project proceeds, it is likely that 50,000 tpa of copper cathode will be exported from Port Hedland.
- Copper-Zinc (Panorama) - This project is at exploration stage and deposits are located 120 km south-east of Port Hedland. Speculative economic plant size is 150-250,000tpa.
- Chromite - Has previously been shipped to China, but is not currently viable. Resource is located at Coobina, 585 km south-east of Port Hedland. Proven reserves are 400,000t, with resources up to 2Mt. Shipping recommenced in 1998/99, exporting 60,000-80,000t per annum.
- Uranium (Kintyre) - Uranium production at Kintyre is planned at a rate of 1,200 - 1,500tpa. A project life of about 15 years is expected.
- Manganese Sulphate - ore to be mined at Ant Hill, 320km south-east of Port Hedland to be processed in Port Hedland prior to export. Approximately 20,000 tonnes per annum may be produced.

3.5.2.9 Basic Raw Materials

Potential development projects in the Port Hedland area and ongoing road construction and maintenance requires the provision of basic raw materials (BRM) such as sand, limestone, gravel and hard rock.

The Port Hedland area obtains supplies of BRM from a variety of sources, including private organisations and Main Roads WA:

- 9 Mile Quarry - located on the south side of the Great Northern Highway on the old Goldsworthy line. This is a local government site that supplies Pindan sand. It is not used regularly.
- Flashbutt site - local government site that supplies river sand. Located near railway area between the tip and the North West Coastal Highway.
- BJ Young - privately owned Pindan quarry located behind the South Hedland landfill site.
- MRWA quarry - located at 21 Mile, provides gravel for road construction for MRWA and Shire roads.
- Turner River Quarry - privately owned site operated by CSR Readymix. Supplies roadbase and aggregates (blue metal) and crackendust for road verges.
- BGC Quarry - privately owned site, supplying aggregate/road base. Located south of the Turner River.
- Tabba Tabba - provides supplies of hard rock.
- Cargill Salt - provides limestone.

Map 7 shows the location of BRM reserves in the Town of Port Hedland.

A BRM study was undertaken for the Shire of Roebourne in 1998 which identified a number of linkages between the Town of Port Hedland and the Shire of Roebourne in terms of the availability of BRM, most significant of which being the relative abundance of sand in the Port Hedland area and the abundance of hard rock in the Karratha/Dampier area. While it is possible to manufacture gravel from hard rock to various specifications, this is more expensive than the use of natural gravel.

At present, the use of BRM occurs in an unco-ordinated manner. Most supplies are obtained from private companies, and there is no overall 'picture' as to the long-term supply and sourcing options within the Town of Port Hedland. It would be useful if an inventory of BRM sites and resources was prepared for the Port Hedland local government area.

3.5.3 Mining and Industry-Based Economic Activity

3.5.3.1 Salt Harvesting

Cargill Salt has a major solar salt operation in Port Hedland, harvesting salt from seawater. The Cargill Salt lease area covers about 7,800 hectares and has the capacity to produce in excess of 2.7 million tonnes per annum. The evaporation ponds in Port Hedland are supported by major lease areas to the east. Brine is transferred through a series of channels and pumping stations running parallel to the coast. The lease areas are shown on Maps 7 and 12.

Current indications are that Cargill Salt does not intend to expand its operation beyond its current leases.

3.5.3.2 Iron Ore

The main industry in Port Hedland is currently the crushing, screening, blending, stockpiling and shiploading of iron ore. This industry commenced in 1962 with Goldsworthy Mining Ltd constructing a 115km railway line from Mt Goldsworthy to Port Hedland. Since this time, BHP Iron Ore has become the major industrial operator in the Port Hedland area, using iron ore deposits, including Mt Whaleback (Newman), Jimblebar and Yandi approximately 460km south of Port Hedland.

Although the Goldsworthy and Shay Gap deposits east of Port Hedland have been exhausted, the Goldsworthy railway line has been extended to the Yarrie deposits.

Processing and shiploading facilities for the Newman and Yandi operations are at Nelson Point. An expansion of the Nelson Point Port capacity is currently under way and will increase capacity to 64Mt per annum.

Finucane Island is used for processing and shiploading of ore from the Yarrie iron ore deposits. The capacity of this facility is in the order of 2Mt per annum. The capacity upgrade at Nelson Point, combined with production from Finucane Island will make Port Hedland the largest iron ore shipping port in the world.

BHP Iron Ore is also the main employer in Port Hedland, employing approximately 1,300 people.

3.5.3.3 Hot Briquetted Iron

BHP has constructed a Hot Briquetted Iron (HBI) plant at Port Hedland, which can produce 2 to 2.5Mt per annum of metallic iron product in a briquetted form. The HBI Project received environmental approval in 1995, construction commenced in 1996 and was completed and commissioned in 1999. There is also a proposal to establish a second stage of the HBI Project, and although this has not been finalised, it remains a possibility. The HBI plant is located adjacent to the proposed Boodarie Strategic Industrial Estate, 7.5km south-west of Port Hedland. The site is approximately 5km from the nearest South Hedland residential area and Wedgefield.

The briquettes are produced through the direct reduction of iron ore fines using modified natural gas. The iron ore fines needed for the HBI process are sourced from Nelson Point and Finucane Island. They are transported from Nelson Point to Finucane Island by a below-harbour tunnel and from Finucane Island by an overland conveyor. In 1999/00, more than 1,066,109t of HBI was exported from Port Hedland. The State Agreement Act for the project requires that no land be zoned Urban within a 5km radius of the HBI plant.

3.6 Infrastructure

Key strategic infrastructure components are indicated on Maps 7 and 12.

3.6.1 Strategic Transport Overview

The Pilbara Regional Transport Strategy was released in 1997. The preparation of the document recognised the Government's focus on transport issues in regions outside the Perth Metropolitan Region, and was one of the recommendations from Pilbara 21. Key recommendations that relate to the Port Hedland area are:

- Prepare strategic port development plans for each port site where industry planning is sufficiently advanced on key projects to determine port needs.
- As part of the 10-year State road program, provide the Ripon Hills connection between Marble Bar Road and Woodie Woodie Road. This will provide a sealed link to the Marble Bar Road by the end of 2002.
- In view of competition policy developments, examine the need and scope for the sharing of key transport infrastructure in consultation with industry and taking into account issues including train scheduling, railway infrastructure constraints and economic viability.
- Develop a State infrastructure fund, based upon a proportion of royalties attracted by resource developments within regions, to be used to contribute to the development of essential infrastructure, including service/infrastructure corridors, new port facilities, and roads required to access remote mining developments.

In 1999, the State Government released *Transform WA* which makes provision for a strategic road link to the Goldfields, which will improve transport between the Goldfields and Port Hedland. The Goldfields Highway (Wiluna to Meekatharra) is estimated to be completed in 2003/04 at a cost of $70 million.

3.6.2 Transport - Roads

Consumables for the local population are primarily moved by road transport, while most minerals are moved by rail. However, a significant number of eastern Pilbara mineral producers truck manganese, feldspar and copper concentrate to the port of Port Hedland for export. Road transport to or from the port may increase significantly, linked to resource projects, which may have a significant impact on the local road network.

The *Roads 2020 Regional Road Development Strategy* identifies a number of regional road requirements for the Pilbara Region. In the Port Hedland area, the two main strategies are:

Great Northern Highway and Port Hedland Road

The strategy is to construct a second carriageway on the Port Hedland Road between the Broome turn-off section and Wedge Street in Port Hedland, and on the Great Northern Highway between the Broome turn-off and Pinga Street (Wedgefield). Duplication of Redbank Bridge will be required eventually to accommodate the dual carriageway.

South Hedland Townsite Roads

The strategy is to provide link roads within the South Hedland townsite to allow more direct movement of local traffic between the townsite localities and east to the Great Northern Highway south of Port Hedland Airport. The needs of cyclists and pedestrians will be considered with the provision of dual-use paths where possible.

Though the priority proposals identified in *Roads 2020* provide an indication of road planning in the Hedland area, the strategy does not allocate funds to any particular project, so there is scope for other roads links to be identified on the basis of future development and expansion scenarios.

Port Hedland acts as a service centre for mineral producers from the eastern Pilbara and most minerals from this region are transported to the port via road trains. An increase in mineral production is likely given the prospect of road upgrades outlined in *Roads 2020*, which would improve access to areas such as the Nifty and Woodie Woodie mines, and the townsites of Marble Bar, Nullagine and Telfer. The *Roads 2020* study is subject to review on a five-yearly basis.

3.6.3 Transport - Railways

Railways in the Port Hedland area are restricted to BHP's Goldsworthy and Newman lines at present. Both of these lines are private, and reserved for the exclusive use of BHP. Recent legal action between major Pilbara mining companies has indicated that there may be limited potential for private rail lines to be shared between companies.

With the potential for a second iron ore producer to establish in Port Hedland, there is a possibility for rail transport corridors to access the port from the western side of the harbour, to the east of the proposed Boodarie Strategic Industrial Estate. It is also possible that the BHP rail corridor to the north and east of South Hedland may be duplicated for a new iron ore industry.

The matter of a rail link into the Boodarie Estate was investigated in a study commissioned by DRD. The 1994 study was an engineering and environmental assessment of the proposed industrial site and associated corridor, stockpile and port sites. The study produced a conceptual

design and layout of the infrastructure required to service the proposed industrial site, corridors, stockpile areas and port sites to accommodate potential industry types. A rail link from BHP's railway was identified, however, the route will be reassessed when a project proposal eventuates.

A new line in from the west could run adjacent to the Great Northern Highway before deviating into the estate to join proposed infrastructure corridors. Alternatively, a parallel line could be established adjacent to the Newman and Goldsworthy lines for access into western side of the harbour. Provision for an additional rail link from the east, south or west into the western side of the harbour is required.

The *State Planning Strategy* indicates a possible long-term link to the Goldfields and ultimately the eastern seaboard. The *Pilbara Regional Transport Strategy* indicates this link between Newman and Leonora is unlikely within the 15-year horizon of the regional transport strategy and suggests it would require a minimum of three million tonnes of freight p.a. to make the route viable.

3.6.4 Ports and Other Marine-Related Infrastructure

Ports

The port of Port Hedland is in a dredged basin at the end of a 20 nautical mile long channel, and is operated and managed by the Port Hedland Port Authority (PHPA). The port has five berths, of which two are owned and operated by the PHPA and three by BHP Iron Ore for the export of iron ore. Two of the iron ore berths are located at Nelson Point and the third is across the harbour at

Finucane Island. In the 1999/00 financial year, more than 65Mt of imports and exports moved through the port.

The PHPA produced the *Port Hedland Port Authority - Port Strategy* in 1995, to guide strategic direction and development within the port authority area. Of particular relevance to this Study is the proposed expansion of the port to the western side of the harbour, and the impact of port expansion on the existing and proposed road network.

The Department of Resources Development and the Port Hedland Port Authority undertook engineering and environmental studies during 1997 to investigate development options for the harbour at future basic berth locations at Utah Point, Stanley Point and Anderson Point on the western side of the harbour. The studies considered four development scenarios which incorporate an additional general cargo, multi-user and iron ore berth, associated stockpiling and laydown facilities, and service corridors to connect to the proposed Boodarie Strategic Industrial Estate.

The three berth locations were reported to be generally acceptable on engineering and environmental grounds, with stockpiling facilities located inland or on the higher ground the preferred option to minimise impact on mangroves. The study excluded the Lumsden Point area between South and South East Creek that was identified as a stockpile and cargo marshalling area in the 1995 Port Strategy. The environmental component of this study did not include formal EPA assessment.

The Port Hedland harbour contains areas of mangroves, and future use of the harbour will need to address the ecological viability of these mangrove stands. In April 2001, the EPA released guidelines for the protection of arid zone mangroves along the Pilbara coastline. This report did not identify mangroves within the PHPA area as being areas of very high conservation value. They were not considered to be regionally significant, although the guideline that relates to the PHPA area did recommend the protection of mangroves and impacts on mangroves be kept to a minimum practical level.

The future expansion of the port area, as outlined in the *Port Hedland Port Authority - Port Strategy*, raises a number of crucial issues. The location and expansion of the port operations may have a significant impact on the surrounding area of Wedgefield, and the hinterland between the two areas. It has the potential to affect infrastructure corridors, road networks and the role and function of Wedgefield.

The PHPA has commissioned a Port Master Plan, to examine the development potential for the port for a 20-year period, and for the "ultimate" development of the site. It is expected that this plan will be completed in 2002/03.

Boating

There are several boating facilities in the Port Hedland area for use by recreational craft. These include boat-launching areas at Port Hedland, Finucane Island and Pretty Pool. The area adjacent to the Spoilbank was under consideration for a small-boat harbour/marina, but was an unpopular choice with local residents and boat users. The development of small-boat facilities is likely to be linked with substantial growth of mariculture, fishing and tourism industries.

The boating needs of the Port Hedland area are linked to operations of the Port Hedland Port Authority, as the port is often used to gain access to tidal creeks adjacent to the port, both for recreation, and for shelter against cyclones. The use of the harbour by recreational boat users is not seen as a major issue for the PHPA, though there may be benefit in educating recreational boat users as to their responsibility in terms of harbour access.

3.6.5 Transport - Air

The Port Hedland International Airport has the only air traffic control service in the region and can accommodate aircraft up to and including 737s. The airport has accommodated larger aircraft from time to time in emergencies, however, regular use of the airport by craft larger than 767s would require an airport upgrade.

The Town of Port Hedland prepared an Airport business plan which proposes a number of commercial land uses associated with the airport, as well as an extension of the main runway. Land on the airport site may be suitable for uses such as transport-related depots, which could be relocated from the prime real estate areas of Port Hedland.

In September 1997, BHP established a construction village on airport land to house 400 workers. The village is on the Great Northern Highway (Broome Road) and was decommissioned following the completion of the construction phase of the HBI Project and Nelson Point Capacity Expansion Project.

3.6.6 Industrial Land

Proposed Boodarie Strategic Industrial Estate

The proposed Boodarie Strategic Industrial Estate has been planned to provide a location in which new strategic industries can establish. The proposed estate is a pro-active initiative to provide suitable land and infrastructure for future industrial development. LandCorp will be responsible for the development of the estate, in its role as the State's industrial land development agency.

The estate is to comprise the following components:

- a heavy industry core;
- a surrounding buffer zone containing support industry; and
- two service corridors linking to the port of Port Hedland area.

By late 1997, two industries had located adjacent to the estate - the BHP Hot Briquetted Iron Project and the Pilbara Energy Pty Ltd gas-fired power station.

Map 10 shows the proposed outline of the Boodarie Strategic Industrial Estate and associated infrastructure and industry areas.

Other Industrial Land

Although the proposed Boodarie Strategic Industrial Estate will provide a site for heavy industry, there is also a need to allocate suitable land for light and general industrial uses, particularly those associated with users of the estate. Land has been allocated in the buffer zone of the Boodarie Strategic Industrial Estate, and the Town of Port Hedland is currently investigating future industrial land options.

The majority of this land, like Wedgefield, is subject to peak storm surge inundation and flooding.

3.6.7 Water Supply

The Port Hedland Water Supply Scheme extracts groundwater from the De Grey River and Yule River Alluvial Aquifers. In 1997, water use in Port Hedland was 40 per cent industry and 60 per cent domestic. The scheme provides water to BHP-Mt Newman and BHP-Mt Goldsworthy through a water agreement with the Water Corporation. The current water agreement is 6.5GL per annum, although current use is approximately 3.0GL p.a.

While covering industrial water use, this agreement also covers domestic use, which has been complicated by the fact that BHP has been selling homes to its employees. The Water and Rivers Commission has recommended the water agreement between BHP and the Water Corporation be renegotiated to exclude domestic water supply.

In 1993/94, 6.6GL of water was delivered from the Port Hedland Water Supply Scheme. BHP intends to use the balance of its current agreement allocation for the HBI Project and Nelson Point Capacity Expansion Project. Scheme demand is then expected to increase to 10GL p.a.

Infrastructure planning is in place to upgrade and automate the borefield and transfer pump station to deliver water at 15GL p.a. from the Yule and De Grey systems. Table 7 summarises the current demand, allocation and capacity, existing and proposed, for the Port Hedland Water Supply Scheme.

As part of its *Pilbara Region Water Resources Review and Development Plan*, the Water and Rivers Commission evaluated several surface and groundwater options to meet medium-term demand. Table 8 illustrates those options. The groundwater resources component in the review notes further investigations are required to enable adequate assessment of resources along the De Grey, Coongan, Turner and Yule Rivers.

Effluent Re-Use

Treated wastewater effluent is used for landscape and recreation watering in Port and South Hedland. The capacity and operation of the South Hedland Effluent Re-use Scheme has been reviewed as part of the South Hedland Enhancement Scheme as the system has been operating below optimum in recent years. This has been due largely to high algae content in the treatment ponds, the length of the pipe to pump water from the WTP into South Hedland resulting in long detention times which causes algae build-up, resulting in odour impacts.

The Water Corporation considers effluent disposal and re-use on an ongoing basis, and a future strategy for the system is required with the end of the construction boom experienced in Port Hedland from 1997-1999.

Water Source	Average Use per annum	Use 1997/98	Allocation	Installed and Ultimate Capacity
De Grey	3.0GL	6.5GL	13.5GL	7.0GL & 13GL
Yule	3.0GL	2.2GL		8.5GL

Source: Water and Rivers Commission; Pilbara Region Water Resources Review and Development Plan, 1996.

Table 7 - Port Hedland Water Supply Summary

Surface Water Supply Options			
Surface Water Options	**Est. Yield**	**Approx. dist. from PH**	**Comments**
Kangan Pool - Yule River (Dam Site 95)	8.0GL	100km	Est. cost $81m. Catchment is in the immediate locality of the Yandeyarra Aboriginal Community. Likely to be used for groundwater recharge.
Marble Bar - Coongan River (Dam Site 85)	26GL	150km	Est. cost $155m. Would have some impact on mining in the area.
North Pole - Shaw River (Dam Site 88)	80GL	130km	Est. cost $122m.
Nullagine River	0-20GL	250km	Not costed due to distance from PH.
Oakover River	20-50GL	300km	Not costed due to distance from PH.
Groundwater Supply Options			
Yule River (extend existing wellfield)	14GL	40km	Considerable potential from a 48km southerly extension along Yule River Alluvium. Est. cost $47m.
De Grey River (extend existing wellfield)	7GL	65km	Considerable potential from a 21km south-easterly extension along De Grey River. Est. cost $40m.Yield is based on current licensing only.
Goldsworthy Town Wellfield (reinstate)	1.5GL	120km	Projected demand may be obtained from existing borefields - option not assessed in detail. Yield is based on previous yields.
Shay Gap Wellfield	na	180km	Projected demand may be obtained from existing borefields - option not assessed in detail.
West Canning Basin	na	260km	Projected demand may be obtained from existing borefields - option not assessed in detail.

Source: Water and Rivers Commission; Pilbara Region Water Resources Review and Development Plan, 1996.

Table 8 - Port Hedland Water Supply - Future Supply Options

3.6.8 Energy Supply

Electricity

Electricity in the Port Hedland area is supplied by the Western Power's integrated North-West network that links Port Hedland to Dampier/Karratha, Wickham/Cape Lambert and Tom Price/Paraburdoo.

Western Power purchases electricity from Hamersley Iron's Dampier Power Station and Robe River Iron Associates' Cape Lambert Power Station. Western Power controls and monitors the North-West transmission network from a control centre at the Karratha Terminal Station.

A 220kV transmission line links the Karratha Terminal to the Hedland Terminal located just south of Wedgefield. Power generation has recently been supplemented with the addition of BHP's Pilbara Energy Pty Ltd (PEPL) gas turbine power station. Addition of the PEPL plant has allowed Western Power to decommission the existing diesel-fired Redbank power station, and rely entirely on the 220kV supply from Karratha. Western Power currently has a standby arrangement with BHP's PEPL Power Station.

The impacts of the Open Access Transmission Policy introduced in 1997 will principally apply to large power producers or users. Development of any future infrastructure will become part of the public domain. The intention of the policy is to reduce the cost of power, particularly for industry and large users and consumers of energy. While it should be noted that the State would not control generation or transmission of power under the policy, the State Government has a Uniform Tariff Policy which is intended to ensure the provision of energy to householders at a uniform cost.

Gas

The PEPL pipeline is 213km long and runs from Dampier to Port Hedland. The pipeline was constructed to supply the PEPL Power Station to meet BHP's existing and future energy requirements in Port Hedland.

3.6.9 Service Corridors

A number of strategic infrastructure corridors traverse the study area. These are shown in Maps 7 and 12 and include the regional road network, railways and high-pressure gas pipelines for resource companies.

At this stage, most industrial infrastructure in Port Hedland is associated with BHP Iron Ore's operations. Due to limited land availability, it is likely that major new resource operations will establish in the proposed Boodarie Strategic Industrial Estate and may use the western side of the harbour for major new loading facilities. It is important that infrastructure corridors be identified and protected in order to accommodate future industry requirements. The proposed Boodarie Strategic Industrial Estate's environmental reports make provision for two 150m service corridors between Boodarie and the western side of the port.

Existing infrastructure lines to Port Hedland are located in a variety of alignments. As Map 7 shows, infrastructure to the west of the townsite is not aligned in any particular way, whereas to the east of the townsite infrastructure is more or less contained in an orderly alignment.

The following is a list of major infrastructure in the Port Hedland area:

Railways

BHP - Port Hedland to Newman - 80m

BHP - Port Hedland to Yarrie - 60m

Roads

North West Coastal Highway

Great Northern Highway

Port Hedland Road

Water Supply

De Grey River to Port Hedland

Yule River to Port Hedland

Gas Pipelines

PEPL Pipeline - Karratha to Port Hedland - 600m wide corridor

Transmission Lines

Western Power 220kV - Cape Lambert to Port Hedland

Communications Network

Telstra Optic Fibre Cable

Shipping Channels

BHP - 200m wide, dredged to a depth of 14.1-15.3m

The provision for infrastructure corridors in the immediate Port Hedland area will be discussed in more detail as part of the Structure Plan.

3.6.10 Solid Waste Disposal

The landfill site for the Town of Port Hedland is east of South Hedland and 1,500m from the nearest residential area. The site is licensed by the Department of Environmental Protection (DEP) as Rural landfill - Management Category C. The management category is an indication of volume, and the South Hedland site is capable of accommodating between 5,000 and 50,000 tonnes of waste per annum. The site is currently classified as suitable for Class 2 waste only, which means inert waste, putrescible waste and low hazardous waste (certain types of metals).

A DEP assessment of the site found that it is capable of rating as a Category D site (more than 50,000 tonnes per annum). However, given that most of the waste to the site at the time of assessment was inert, being associated with construction of the HBI plant, and that approximately 16 tonnes of putrescible waste per annum was deposited at the site, it was considered unfair to assess the site as a higher grade when most of the waste was associated with construction. Subsequently, the site was reclassified as Category C.

The landfill site operates within State policies. A standard landfill buffer zone is 500m from the face of putrescible waste, and the South Hedland site is 1500m from the nearest residential area. There are no beneficial users downstream from the site. The life of the landfill depends largely on the rate of urban encroachment, although management of the site will determine the extent to which residential areas are affected.

3.6.11 Regional Waste Disposal

The DEP engaged a consultant to investigate the need for a Class 4 landfill in the Pilbara that could accommodate hazardous waste, more metals, lead, mercury, pesticides and hydrocarbons. The report findings suggested that the current and forecast amount of low-hazard waste for disposal to a secure landfill at Karratha and Port Hedland indicates the need for the development and operation of sites at each of these locations. The annual volumes estimated indicate that a 30,000m^3 secure landfill at Port Hedland will accommodate waste for about a 10-year period. A secure landfill of this size could be housed within a waste management centre so facilitating effective management and minimising transportation and operational costs.

This study did not identify potential landfill sites, and this needs to be undertaken in the Port Hedland area in the short to medium term. EPA Bulletin 874 (Dec 1997) recommends that DEP, LandCorp and DIR review the suitability of current landfill sites. In the short term, the Shire of Roebourne's 7 Mile Waste Management Facility may be able to accept some waste.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4.0 Port Hedland Area Planning Study

This section addresses the findings of current available reports and initiatives as identified in Chapter 3. It presents a balanced and integrated study which is designed to encourage social and economic development in the Port Hedland area consistent with responsible management of the natural environment.

4.1 Principles Guiding the Study

The Port Hedland Area Planning Study (PHAPS) is based on the principles set out in the *State Planning Strategy* and the *Pilbara Land Use Strategy*. The intent of the principles relate to the strategies developed for the Port Hedland area. The primary purpose of the Study is:

To provide a link between State, regional and local planning which is based on a balance of economic, social, cultural and environmental considerations.

Based on this purpose, the following broad principles provide the foundations for the Study:

4.1.1 Principles from the State Planning Strategy

4.1.1.1 Environmental Principle

To protect and enhance the key natural and cultural assets of the State and deliver to all Western Australians a high quality of life which is based on environmentally sustainable principles.

Healthy and resilient natural systems are an important part of the heritage of the area and also help to maintain essential life-supporting resources such as clean air, water, soil and biological diversity.

Strategies have been designed to provide a balance between conservation of important components of the natural environment while using natural resources within their capabilities. There is a need to recognise that some resources are non-renewable and that the long-term interests of the area may be better served by the economic use of resources based on sustainability.

4.1.1.2 Community Principle

To respond to the social changes and facilitate the creation of vibrant, safe and self-reliant communities.

Strategies have been designed to facilitate the provision of community infrastructure for the whole local government area which will help to achieve more equitable access by the community, a greater range of services and overall cost savings. An approved statutory framework for the whole local government area will assist with demands for land and service provision, giving communities a chance to become more involved in the planning process.

Future growth and development should enhance the sense of place and belonging of the community and strengthen the area's identity for locals and visitors. The history and heritage of the area and the way it is regarded by the residents is the foundation for its identity.

4.1.1.3 Economic Principle

To actively assist in the creation of regional wealth, support the development of new industries and encourage economic activity in accordance with sustainable development principles.

Strategies have been designed to assist in broadening the economic base of the area by building on its traditional primary industries with greater downstream processing, the use of natural resources for tourism and aquaculture and the creation of service sector employment opportunities. Broadening the economic base of the area will help provide a stable basis for community development.

4.1.1.4 Infrastructure Principle

To facilitate strategic development by making provision for efficient and equitable transport and public utilities.

Strategies have been designed to integrate land and water use and infrastructure in order to contribute to economic development by ensuring that efficient transport systems are planned, strategic infrastructure is identified, secured and co-ordinated, and ensuring that the provision of public utilities is based on economic and social considerations.

4.1.1.5 Regional Development Principle

To assist the development of regional Western Australia by taking account of the special assets and accommodating the individual requirements of each region.

The strategy provides a framework to co-ordinate and promote planning and development to ensure a high level of co-operation between government agencies. Decentralisation of State Government agencies and improved access to information will assist in maintaining coordination and co-operation.

Delegation of decision-making powers will assist in the timely processing of planning proposals and making decisions that are relevant to local conditions.

4.1.2 Principles from the Pilbara Land Use Strategy

4.1.2.1 Multiple Land Use Principle

To facilitate multiple land use and avoid fragmentation, duplication, conflict and unnecessary delays.

The strategy seeks to provide for a harmonious mix of various uses while seeking to ensure conflicting uses are managed and do not detract from the safe and sustainable use and enjoyment of surrounding areas for appropriate purposes.

4.1.2.2 Sustainable Development Principle

Promote sustainable development in the planning of the area to enhance the quality of life for residents and visitors, both now and in the future.

Sustainable development is a term used internationally and nationally and seeks to integrate economic, environmental and social considerations into decision-making. It contributes to many broad objectives, including community well-being and equity within and between generations It is defined as "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" from the World Commission on Environment and Development's (the Brundtland Commission) report Our Common Future (Oxford: Oxford University Press, 1987).

4.2 Strategic Policy Framework

This section of the report presents a policy framework based on principles, issues and policy responses with the discussion arranged into categories of land and water use. At the end of each recommendation, a lead agency or agencies and associated agencies are listed to work together to implement the recommendation. There are many private and community groups and individuals who may need to be involved to implement specific recommendations. Appropriate groups and individuals should be consulted when recommendations are considered for implementation. Map 8 shows the proposed Land Use Plan.

The Study recognises other government agencies' programs which are designed to bring together the activities of many agencies, organisations and community groups at different levels of government or with different objectives, State Government Ministers or legislation. The Study reflects the many policies, strategies and recommendations documented in current approved studies and reports for the Pilbara Region, and more specifically for the Port Hedland study area.

It is not the purpose of this Study to repeat each individual recommendation in the various reports and studies. This Study identifies and defines existing and planned land and marine use commitments by the various reports and makes recommendations for further research and planning to fill gaps in current information and data.

Environmental and Cultural

Principle from the State Planning Strategy

To protect and enhance the key natural and cultural assets of the State and deliver a high quality of life which is based on environmentally sustainable principles.

Issues in the Port Hedland area

- Areas with environmental values are not recognised and subject to misuse.
- Impacts of noise and dust from industrial operations at Nelson Point and Finucane Island.
- Access to Port Hedland harbour area by recreational boat users.
- Protection of coastal mangrove communities.
- Identification and protection of Aboriginal heritage and other sites in the context of other land uses.

WAPC policy

The WAPC will use its statutory land use decision-making powers and responsibilities to secure those natural and cultural assets of the study area for the enjoyment of future generations. In order to achieve this, it will seek the support and co-operation of other State Government agencies and in particular the Town of Port Hedland, as well as Aboriginal Communities, the private sector and residential landowners.

Actions to achieve policy position

- Reserve Munda Beach and Cowrie Creek as an environmental protection and recreation reserve, with joint vesting between CALM and the Town of Port Hedland. (**CALM/TPH**, DOLA)
- Review the *Port Hedland Coastal Plan* and widen the study area to include coastal area within the entire local government area and address access to coastal areas. (**TPH/DPI**, CALM, DEP, PDC)
- Support the implementation of guidelines for the protection of arid zone mangroves along the Pilbara coastline. (**DEP**, all agencies)
- Support Air Quality Monitoring program. (**DEP**)

Proposals requiring further investigation

- Investigate the environmental and conservation values and agricultural potential of the lower De Grey River, and make recommendations for its future use. (**CALM**, DEP, WRC, AGWA, TPH)
- Investigate reservation of Cemetery Beach, with joint vesting between CALM and the Town of Port Hedland. (**CALM/TPH**, DOLA)
- Devise appropriate management strategies to protect Aboriginal sites in the context of other surrounding land uses. (**DIA**, TPH, CALM, DPI)
- Identify additional areas for environmental protection and recreation with a view to subsequent reservation and management. (**CALM/DEP**)

Community

Principle from the State Planning Strategy

To respond to social changes and facilitate the creation of vibrant, safe and self-reliant communities.

Issues in the Port Hedland area

- Residents and tourists have difficulty accessing coastal areas, limiting recreation opportunities.
- There is a lack of suitable housing for Aboriginal people, particularly those visiting town.
- Housing and community services are put under pressure with rapid population increases associated with resources development.
- There is an ongoing need to improve townscape and amenity.
- The future aspiration of Aboriginal Communities.
- The Impact of cyclones, storm surge and flooding events.

- The adequacy of existing social services and future service needs.
- The impact of increased port activity on the local road network.

WAPC policy

The WAPC will encourage proposals and activities leading to the creation of attractive communities or enhancement of existing communities in the study area. This will apply to the major urban settlements of Port and South Hedland as well as individual Communities, the private sector and individual landowners.

Actions to achieve policy position

- Prepare an implementation plan for any outstanding projects as the South Hedland Enhancement Scheme winds up its activities. (**TPH**, PDC, DPI)
- Town of Port Hedland formally to endorse revised Townscape recommendations and implement accordingly. (**TPH**)
- Support preparation of layout plans for Aboriginal Communities. (**WAPC/DPI**, DIA)
- Support the preparation of the Storm Surge Emergency Management Plan. (**FESA**)

Proposals requiring further investigation

- Prepare a short-stay accommodation inventory detailing potential sites for accommodation camps and tourist accommodation and their status in terms of zoning, Native Title and capacity. (**DPI**, TPH)
- Prepare Social Impact Assessments for all strategic industrial developments, with release of an EPA Bulletin for the project as the catalyst. (**DPI/DIR/TPH**)
- Undertake a detailed analysis of future heavy vehicle transport movements for the greater Port Hedland area and identify possible network conflicts and options. (**MRWA**, DPI, DIR, TPH)
- Assess the proposed Boodarie Strategic Industrial Estate Buffer Zones in response to the State Industrial Buffer Policy and assess impacts on surrounding land uses. (**WAPC**, DEP, DIR, LandCorp)

Regional Development

Principle from the State Planning Strategy

To assist the development of regional Western Australia by taking account of the special assets and accommodating the individual requirements of each region.

Issues in the Port Hedland area

- Decisions affecting the region are often made outside the region, especially from Perth.
- There is a need to ensure co-ordinated actions from Government.

WAPC policy

The WAPC recognises the importance of the study area's economy to the creation of wealth in the State. This Study provides a means for the various arms of government can be co-ordinated through a locally based implementation mechanism, which is a principal aim of the Commission.

Actions to achieve policy position

- Establish a locally based regional co-ordinating committee to progress implementation of the Port Hedland Area Planning Study. (**WAPC/DPI**)
- Prioritise recommendations for implementation. (**Co-ordinating Committee**)
- Review the Study every five years. (**DPI**)

Infrastructure

Principle from the State Planning Strategy

To facilitate strategic development by making provision for efficient and equitable transport and public utilities.

Issues in the Port Hedland area

- The need to plan for efficient infrastructure corridors throughout the sub-region.
- The capacity of waste disposal facilities and location of new sites.

WAPC policy

WAPC recognises that the area relies on the provision of physical and social infrastructure for economic effectiveness and efficiency. The Commission will pay particular attention to the need to set aside and secure land for the provision of necessary infrastructure and service corridors.

Actions to achieve policy position

- Define infrastructure corridors for future linkages from the region into the greater Port Hedland area. (**DIR**, MRWA, PHPA, DPI)
- Protect infrastructure corridors through the Town of Port Hedland Town Planning Scheme. (**TPH**, WAPC)
- Locate future infrastructure in identified service corridors. (**all servicing agencies**)

Proposals requiring further investigation

- Identify landfill sites to cater for putrescible, inert and Class 4 waste and recycling. (**DEP/ TPH**, DIR, LandCorp)

Economic

Principle from the State Planning Strategy

To actively assist in the creation of regional wealth, support the development of new industries and encourage economic activity in accordance with sustainable development principles.

Issues in the Port Hedland area

- Port Hedland has a narrow economic base.
- Port Hedland needs to secure basic raw materials (BRM) supplies and determine long-term supply options.
- There is uncertainty as to future commercial and industrial land supply.

WAPC policy

The WAPC will seek to ensure that the economic development of the area is able to flourish through the provision of available and suitable land for industrial and commercial activities. Additional economic activities designed to expand the area's economic base will be actively encouraged.

Actions to achieve policy position

- Ensure an adequate supply of commercial and light industrial land to support community and industrial development. (**TPH**, DOLA, LandCorp, WAPC)
- Advance horticulture project for Turner River precinct. (**AGWA**, WC)
- Maximise economic benefit from PHPA by allowing multi-user access. (**PHPA**, DPI)
- Support ongoing implementation of the *Pilbara Economic Development Strategy*. (**PDC**)

Proposals requiring further investigation

- Identify suitable marine and land-based sites for aquaculture and associated support facilities in support of the *Pilbara Land Use Strategy*. (**DoF**, CALM, DEP, DPI, PHPA, DIR)
- Prepare a tourism strategy for the Town of Port Hedland, identifying existing tourist products and infrastructure, possible tourist sites, development options and tourist markets. (**PDC**, CALM, AGWA, MRWA, WATC, DPI)
- Support the preparation of a development strategy and land use plan for the proposed expansion of the port of Port Hedland, including infrastructure corridors connecting to proposed Boodarie Strategic Industrial Estate. (**DIR/PHPA**, DEP, MRWA, DPI)
- Undertake a basic raw materials study in the Town of Port Hedland, identifying existing and future BRM sources and zone the land accordingly under the Town of Port Hedland Town Planning Scheme. (**TPH/DIR**, MRWA, WAPC)


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5.0 Port Hedland Structure Plan

5.1 Introduction

Recent Townsite Development

The advent of industrial development in the 1960s led to a significant increase in population. The coastal townsite extended east to Spinifex Hill and Cooke Point during this period. A small workforce was also housed at Finucane Island which subsequently has been dismantled. As limited land was available for residential expansion on the coast, South Hedland was established in the late 1960s. Wedgefield, the industrial area between Port and South Hedland, also accommodates a significant population component.

In the period from 1971-76, development concentrated in the South Hedland area. Between 1976-81 there was a decline in population in all localities except South Hedland, which grew at an annual rate of 10 per cent. Initial development in the Pretty Pool locality on the coast in 1986 provided a limited alternative housing option. However, the focus of Port Hedland's residential and commercial growth since the mid-1970s has been predominantly in South Hedland.

At present, there are three main population centres in the Hedland area - Port Hedland, South Hedland and Wedgefield. Port Hedland accommodates approximately 30 per cent of the population, South Hedland 60 per cent and Wedgefield and other rural areas 10 per cent.

Since 1990, studies have been completed relating to Coastal Management (1992) and Townscape (1991). Many of the recommendations have not been implemented, and it is now timely to review these documents to ascertain the relevance of those recommendations have yet to be implemented.

The South Hedland Enhancement Scheme (SHES) initiated in 1995 was a joint project between the State Government, BHP Iron Ore and the Town of Port Hedland, aimed at improving the quality of life for residents of South Hedland. The SHES has reviewed many of the Townscape recommendations from the 1991 study.

Study Area and Time Frame

The study area for the Structure Plan is broadly marked by the coast to the north, the proposed Boodarie Strategic Industrial Estate to the west, 12 Mile Creek to the east and the South Hedland area to the south. The Structure Plan is designed to guide townsite development in Port Hedland for a 30-year period, although it will be subject to regular review.

Similar to the 1984 development strategy prepared as part of the review of Town Planning Scheme No. 3, a target population of 40,000 has been adopted as a basis for possible growth and development. The realisation of the target population over the time frame is highly dependent on new industrial development in the proposed and significant increases in exports of Pilbara resources through major expansion to the port.

Planning Context

The Port Hedland Structure Plan is a component of the Port Hedland Area Planning Study (PHAPS). The land uses displayed in this plan are complementary to PHAPS, but are shown in greater detail.

Objectives

The objectives in preparing a Structure Plan for the Port Hedland area are to:

- provide a basis for local strategic land use decision making;
- provide for growth and ensure that public utility and community services are planned and can be provided in a timely and co-ordinated manner;
- ensure that development is environmentally acceptable; and
- preserve and enhance amenity and lifestyle.

5.2 Current Zoning and Development

Current Zoning

Map 9 indicates the extent of the zones on Town Planning Scheme No.5 for the Port Hedland townsite, which was gazetted in 2000. TPS No. 5 covers the entire local government area of Port Hedland.

Development

Table 9 outlines the nature and extent of residential, commercial and light industrial development at September 1995.

Land Description	Residential (dwelling units)	Retail/Other Retail (floorspace m²)	Office, business, recreation and cultural (floorspace m²)	Industry, Storage, Manufacture, Processing (floorspace m²)
Port Hedland (including Nelson Point, Finucane Is)	1,338	14,722	9,776	51,782
South Hedland	2,622	18,140	8,470	6,333
Wedgefield	62 (& 640 SPQ units)	5,375	1,030	50,683
TOTAL	4022 (& 640 SPQs)	38,237	19,276	108,798

Source: Ministry for Planning, Port Hedland Land Use Survey & Land Development Program, 1997

Table 9 - Major Land Uses in Port Hedland

5.3 Planning Considerations

5.3.1 Townsite Development

Port Hedland

The significance of the original commercial and administrative centre of the coastal township in the vicinity of the port has been progressively reduced since the 1970s with the development of South Hedland and more recent shopping and civic facilities located just west of Spinifex Hill.

The port area offers substantial opportunities for redevelopment and townscape enhancement as outlined in the 1991 Townscape Plan. The provision of sewerage facilities will assist redevelopment in the older Port Hedland area.

Development proposals for the Pretty Pool area have been prepared at the initiative of the Town of Port Hedland. The proposals require resolution of a number of major constraints including environmental assessment and land tenure. The proposals are significant and indicate potential to provide land to support 1,000 additional dwelling units. The projects require substantial and potentially costly earthworks over existing tidal flats to raise the ground level enough to protect development from storm surge.

The Town of Port Hedland has allocated funds to upgrade the Pretty Pool foreshore area through the Pretty Pool Development Plan, which will be staged over several years. Concept plans are in place to upgrade the area, and funding will be allocated over time.

Wedgefield

Wedgefield has been developed as an area for general industry, and previous town planning schemes have made provision for caretakers' dwellings to be located on site. This has resulted in a substantial permanent population being located in the Wedgefield area, as well as the periodic influx of construction workers in the

Transient Workforce Accommodation zone and other sites throughout Wedgefield. While residents of Wedgefield have tended to view the area as a light industrial area, town planning schemes for the area have zoned Wedgefield as general industry, which permits a wide range of industrial land uses, some not compatible with residential living.

In order to develop a long-term solution to achieve a reasonable mix between light industry, general industry and the associated residential component, the Town of Port Hedland has initiated a Industrial Land Strategy for the entire local government area. This study will determine which areas are suitable for light industry and residences, and which areas should be left solely for general industry purposes.

South Hedland

The South Hedland area was originally designed for a population of 40,000 in a configuration of four neighbourhoods located symmetrically around the town centre. The first to be developed were the recently named suburbs of Lawson, Walnut Grove, Shellborough and Cassia - based on Radburn design principles.

Due to objections regarding the suitability of the subdivision, subsequent developments in the Koombana neighbourhood were based around more conventional subdivision design. While it was intended that the town centre be central to South Hedland, it is currently on the western edge of South Hedland and adjoins residential areas only to the east and south. The town centre is close to South Creek and has associated flood risk, so it is not possible to surround it with residential development.

5.3.2 Social and Community Considerations

The inappropriate subdivision of South Hedland in the late 1960s resulted in a low-quality visual environment and well-documented social problems. As a response to the ongoing social problems and the poor public perception of South Hedland, the South Hedland Enhancement Scheme (SHES) was established in 1995. The scheme was part of the State Agreement between the State Government and BHP Iron Ore and aims to address concerns about the quality of life

experienced by residents of South Hedland. The scheme is a jointly funded $7 million project that aims to improve the living environment for residents of South Hedland and also for the new townspeople who are expected as a result of BHP's operations in the area. The work undertaken by the SHES has included, but is not limited to:

- construction of footpaths and major street lighting upgrade, although maintenance work is not carried out by the SHES;
- construction of link roads to join the residential precincts;
- improvement of visual amenity by streetscape initiatives such as tree planting, entry statements, landscaping;
- undertaking a recreation needs study;
- undertaking a Planning Options and Opportunities study;
- closure of walkways and amalgamation into residential lots;
- promotion and exposure of issues; and
- formation of an Inter-Departmental Committee to co-ordinate social and development issues as they relate to South Hedland.

It is expected that the project will improve community, leisure and recreational facilities in South Hedland. The SHES had a finite life and ceased operation in 1999, at which time the ongoing management for South Hedland reverted to the Town Council.

The construction phase for the HBI Project had a significant impact on the rental housing market.

While those workers directly associated with BHP were adequately accommodated, there was considerable concern regarding the number of people living in caravans and other temporary housing, particularly in Wedgefield.

The *Port Hedland Land Development Program* released in October 1997 recommended that consideration be given to future State Agreement Acts requiring the preparation of a Social Impact Assessment for the construction and operational phases of major resource projects to alleviate the housing issues experienced in Port Hedland. This study supports that recommendation.

Social and Community Infrastructure

Certain sections of Port Hedland are well serviced by social and community infrastructure, although there is some difficulty in providing similar levels of service to two discrete communities about 15km apart. South Hedland has the largest population and does tend to attract most new services, but Port Hedland is the historic centre and has retained a high level of service. Inevitably there has tended to be a certain amount of duplication, although some major services are currently located in one centre, i.e. Port Hedland Regional Hospital in Port Hedland and the District High School in South Hedland. Social and community infrastructure is shown on Map 11.

Public Transport

Public transport is available in Port Hedland and serves to link the two communities of Port and South Hedland. Hedland Bus Lines operates the public transport bus service under licence from the Department for Planning and Infrastructure. The service operates on a regular basis six days a weeks between Port and South Hedland and includes deviations into Cooke Point and Pretty Pool. However, the service is limited and does not operate on weekends or public holidays.

Provision of public transport in the Pilbara Region is problematic, as population levels are not sufficient to generate a full metropolitan-style service. Increased promotion of the Hedland bus service, including clearly identifiable bus stops, buses and bus routes, could assist in attracting more passengers to the service.

There are 22 licensed taxis in the Port Hedland area to supplement community transport needs.

Cultural, Entertainment, Shopping

Port Hedland has a range of cultural and entertainment facilities. It has libraries in Port and South Hedland and a theatre in South Hedland as well as a range of community groups associated with entertainment and cultural interests. Port Hedland also hosts a number of travelling shows such as musical performers and theatrical productions.

Shopping needs are well catered for in Port Hedland for most sections of the community. The South Hedland Shopping Centre is the largest centre in the area, followed by the Boulevarde Shopping Centre in Port Hedland. Neighbourhood shopping centres also exist in Lawson Street, South Hedland and in Cooke Point, Port Hedland. Wedge and Edgar Streets in Port Hedland are the town centre of Port Hedland and contain a number of commercial premises as well as accommodation and office space.

Townscape and Urban Design

The town centres in Port and South Hedland lack a visual centre. While acting as magnets due to the function they serve, both town centres lacks identity, especially for visitors to the town. So too, many of the buildings constructed in the Wedge and Edgar Street area are not in keeping with the history of the town, and do nothing to reinforce the rich heritage of Port Hedland. While some buildings in Edgar Street have been refurbished, there is a need to ensure that future development is in keeping with the role of Wedge and Edgar Streets as a town centre.

In 1991, the then Department of Planning and Urban Development released the *Port Hedland Townscape Study*. This made a number of recommendations to improve the appearance of the townsite. A review of the Townscape plan as it relates to South Hedland was completed in 1996 and a similar review was undertaken for Port Hedland in 1997. The South Hedland review revealed that only four recommendations had been fully implemented, and many recommendations that had been partly implemented were still identified as having a high priority. The Town

Centre Development Plan for Port Hedland should assist in the revitalisation of the centre.

Main Roads WA is responsible for the road verges of its roads, which should be considered as part of any beautification program for the Port Hedland area.

Education

Port Hedland has a full range of educational facilities and services, ranging from pre-school to vocational and tertiary education. There are many programs and training opportunities specially allocated for people who live in the Port Hedland area, including a TAFE college.

At present there are five public primary schools and one high school in Port Hedland, plus a private primary school and high school. The Port Hedland Primary School was closed in 1998 and amalgamated with the Cooke Point Primary School, which was redeveloped into a more modern facility.

Health

The Town of Port Hedland has a range of health services and houses the Port Hedland Regional Hospital, a 90-bed facility. The hospital meets the specialised medical needs of residents from all over the Pilbara Region. The hospital is in the Port Hedland townsite and provides a range of specialist services, including paediatrics, obstetrics, gynaecology, radiology, anaesthetics and general surgery. Hospital services are supported by regular visits from Perth-based specialists.

Within the townsite there is a range of medical services such as general practitioners, dental services, Aboriginal health services and community nursing. There are also Home and Community Care programs and the town has a frail-aged hostel which services the Pilbara. The Patient Assisted Travel Scheme (PATS) is available to residents who need specialist treatment outside the region.

Provision has been made for a future hospital on a 16ha site in South Hedland, to the west of Hamilton Road. However, the Health Department has plans to upgrade the existing hospital in Port Hedland and is investigating the acquisition of adjacent land formerly occupied by the Port Hedland Primary School. Consolidation of the existing regional hospital is likely to affect the long-term need to construct a new regional hospital in South Hedland. This may allow the land to be used for other community/cultural purposes.

However, there is a need to acknowledge that future growth will occur principally in South Hedland, and on this basis it may be reasonable to suggest the hospital would be best placed in the South Hedland townsite. As the hospital serves a regional function, serving communities throughout the Pilbara, relocation of the facility about 15km away is minor in a regional context.

Community Services

Port Hedland is well serviced by a range of community services such as Centrelink, to State Government agencies such as the Department for Community Development and Disability Services Commission. There is also a range of community-based groups including Well Women's Centre, Red Cross, Lions Club and a variety of support and interest groups.

A Lotteries House was constructed in the South Hedland town centre in 1998 and now provides office space and services for a range of community and social service groups.

Recreation

There are a number of recreational facilities in Port and South Hedland. There are aquatic centres in both areas, a major outdoor sporting complex in South Hedland and a similar venue in Port Hedland. Activities available include swimming, indoor hard-court sports, tennis, squash, football, art and crafts, and dancing. There is a multitude of community sporting organisations for specialised sports, as well as other recreational pursuits such as fishing and four-wheel driving.

The SHES commissioned the *Port and South Hedland Sport and Recreation Needs Study*. The key recommendations of this report were that:

- an incorporated Community Recreation Association be established to manage community recreation and sport facilities within the Town of Port Hedland;

- commitment be made by the Town of Port Hedland and BHP (and other major employer organisations) to a practical annual subsidy for the management of all recreation facilities within the towns, particularly for the JD Hardie Centre; and
- the Spoilbank to be established as a major recreation centre.

However, it should be noted that the Spoilbank area is extremely vulnerable to cyclonic events and not capable of accommodating permanent built structures of any kind. The recommendations from the report were divided into three stages. It was suggested that Stage 2 should be completed within three years, and Stage 3 within five years. In addition, Pretty Pool has been identified in a Town Council report as a major recreation destination for Port and South Hedland residents.

Lifestyle

There is evidence to suggest that people are staying in the Hedland area for longer periods of time and there is an increasing long-term population. This is supported by 1996 Census results which indicated that more than 50 per cent of residents had lived in Port Hedland at the previous Census.

Enhancement and promotion of the 'North-West' lifestyle can play a role in ensuring the long-term viability of Port Hedland and should be a major consideration in the planning and development of the town. Provision of a range of lifestyle and recreational pursuits is a vital part of future planning in the area. This includes the allocation of land for hobby farm lots and the identification, protection and development of recreation nodes in the area.

5.3.3 The Natural Environment

Landforms and Vegetation

The townsite area of Port Hedland consists of the following landforms and vegetation:

- inter-tidal Flats
- scrub/Vegetation
- stable Dunes - although some are classified mobile
- saline Coastal Flats
- mangroves

As outlined in the Issues and Opportunities Report prepared for the Town Planning Scheme No.5, the "environment is considered harsh for human habitation, yet extremely vulnerable to natural and human impacts". Because of the flat nature of the terrain and significant tidal range, much of the coastal area where development has occurred is surrounded by extensive areas that are subject to inundation. Mangroves are a key component in maintaining the ecological balance of the area.

Urban Geology

In terms of urban geology, the coastal townsite is located predominantly on young beach and dune shell sand with residual silty sands south of the coastal ridge in the Pretty Pool area interspersed with mud and silts in the tidal flats. To the south, the tidal flats around the harbour are primarily mud and silts with red-brown silty sand above the tide range. Most of Boodarie, Wedgefield and South Hedland is located on older red-brown silty sands. The area is interspersed with clayey sand and several north-south veins of high-level sands, one of which runs south through the centre of South Hedland from the elevated ground where the water tower is located.

The geography, soils and climate combine to make the drainage of Port Hedland a significant factor in the development of the town. Port Hedland itself is surrounded by salt flats and tidal areas. Wedgefield, South Hedland and Boodarie are located on a drainage plain which discharges to South Creek and South West Creek. As such there is limited available land that is not influenced by some form of environmental constraint.

Cyclonic Activity

Port Hedland is in a cyclone-prone area, with cyclones most prevalent between November and April. Cyclones may cause damage in three main ways - collapse of buildings and other structures due to fluctuating wind pressure, loose objects can become airborne projectiles from high wind speeds, and can occur as a result of ocean storm surge, heavy rainfall in river catchments, or a combination of both.

The Town of Port Hedland is in Region D, a Category 2 area in terms of the Building Code of Australia provisions. Most of northern Australia is in Region D. The Category 2 rating relates to the likely ferocity of winds in the area should a cyclone occur and is the highest rating for winds. This rating applies generally between Onslow and Cape Keraudren.

Storm Surge and Flooding

In 1998, the Ministry for Planning, the Town of Port Hedland and the Department of Resources Development commissioned a study into the combined effects of storm surge and rainwater flooding in the area from the Turner River to 12 Mile Creek. This study provided a series of maps showing the likelihood of inundation for the 50 and 100 year return periods.

This research does not provide a single contour level for "safe" development. Rather, the results of the study have been incorporated into the Town of Port Hedland's Town Planning Scheme No. 5, which will restrict development in those areas considered to be at risk from inundation. This is shown on Map 4.

The Main Roads Department prepared the *Town Planning Flood Study for South Hedland* in 1975 *"to determine the constraints upon development of South Hedland from flooding of the South and South West Creek systems, and to design town flood protection to increase land use in the flood prone area. The design flood has been taken as the 100-year return interval event"*.

The study indicated the North West Coastal Highway should be passable with a flood having a 20-year return period. The report noted evidence of past flooding from cyclone Kerry in 1969 which represented a 1 in 20 year flood event. The Goldsworthy Railway across South Creek was washed out and there were eyewitness claims of flooding from South West Creek into South Creek.

The 1975 study defined the flood level and limit of western townsite development which would require flood protection by levees constructed to a minimum level of 13.0-15.0m AHD. This levee has not been constructed to date as it forms part of the long-term outer ring road around South Hedland. The existing commercial centre of South Hedland is constructed at about 13m AHD.

It is important to note that the results of this study relate only to development levels, where property is at risk. For planning purposes, the 1 in 100 year inundation level is used throughout Australia as an acceptable level of risk for property. The 1 in 100 year event is not considered an acceptable level of risk for emergency evacuation and response purposes. The State Emergency Service is the agency responsible for managing the impacts of severe weather events, particularly in relation to household evacuation where lives are considered to be at risk. The State Emergency Service do not have a set return period i.e. 1 in 250 or 1 in 500 for determining when and where householders are advised to evacuate their homes in the case of a likely storm surge inundation.

Drainage

The South Hedland townsite incorporates a significant drainage system to direct run-off away from the residential areas. Drainage to the east of the vein of high-level sands includes approximately half of the original neighbourhood. The majority of Koombana drains to the north-east to a large basin beyond the North Circular Road. The area west of the high-level sands drains to South Creek north and south of the town centre.

Much of the remaining area south of the harbour is subject to sheet flooding because of the flat topography and undefined drainage channels.

5.3.4 Natural Conservation Values

The main areas with conservation values in the Port Hedland townsite are:

- the mangrove areas and creek lines on the coastal mudflats and inlets, especially at Pretty Pool and 4 Mile Creek;
- Pundul Trees in South Hedland;
- Coastal dune and foredune area from Cemetery Beach to Cooke Point;
- Cemetery Beach as a turtle rookery; and
- Aboriginal sites throughout the townsite.

The protection of these areas is primarily a local government role, in conjunction with relevant agencies such as DIA and CALM, particularly in providing justification and scientific explanations as to why the areas are worthy of reservation. There is a need for areas with natural heritage value to be identified and the potential impacts of development proposals, sediment loading, surface run-off and erosion impacts on these areas minimised.

5.3.5 Current and Potential Environmental Issues

Air Quality

BHP's iron ore operations at Nelson Point and Finucane Island have a considerable dust impact on the local community. As a response to community concern, BHP has developed and is implementing a program to improve management of the dust impact. Details of BHP's proposal and obligations under the *Environmental Protection Act 1986* are outlined in *EPA Bulletin 831*, October 1996. While the program may improve the dust management issues in Port Hedland, it will not be possible to eliminate iron ore dust particles from the air entirely. Irrespective of the dust management program, there should be an emphasis on maintaining the present landscape and community use buffer zone along Anderson Street as defined in the 1984 Development Strategy prepared as part of the review of Town Planning Scheme No. 3., rather than compromise BHP's present operations.

It should also be noted that noise and odour impacts may be generated from particular development and construction sites from time to time.

Noise

Train marshalling yards at Nelson Point operating 24 hours a day have an impact on noise levels in Port Hedland. BHP's Capacity Expansion Project has reduced this impact with the provision of a rail loop and removing the need for train marshalling (i.e. shunting, with its attendant noise output).

New noise regulations have been implemented by the EPA which set limits for noise levels. These will affect new industrial developments, but will not be applied to existing operations.

The Environmental Report for the proposed Boodarie Strategic Industrial Estate makes substantial buffer provisions. Industry-specific emission data is not known for the different types of industry which potentially might locate in the Boodarie Estate. The levels of risk, air quality or noise emissions would depend on the size of the industry (production capacity) and its technological basis. A buffer zone was determined by modelling the cumulative impacts of various development scenarios based on potential industries using the natural resources of the region. Existing environmental approvals are in place for 4km and 5km noise buffers to the PEPL Power Station and HBI plant respectively. These buffer zones are indicated on Map 10.

5.3.6 Existing Service Infrastructure

The following section details the current status of servicing in the townsite and extensions that may be required.

Energy and Power Distribution

Power generation and transmission have been discussed previously in the sub-regional context.

Power in the greater Port Hedland area is distributed from Hedland Terminal south of Wedgefield through a network of 66kV transmission lines linking sub-stations at:

- Port Hedland — Anderson Street (WPC) Nelson Point (BHP)
- Wedgefield — (WPC)
- Finucane Island — (BHP)
- South Hedland — Murdock Drive (WPC)

The 66kV transmission network is generally adjacent to major arterial roads or railways. However, the 66kV feeder from the PEPL Power Station to the Murdock Drive sub-station in South Hedland is in a 30m easement adjacent to Koombana Drive before turning north and traversing future urban land in East Koombana. The line currently splits the future residential area and future relocation further east to North Circular Road or relocation underground through the residential area will need to be incorporated in future detailed planning. Timing of any future relocation is likely to be 10-15 years away.

Pilbara Power, Western Power's Pilbara Division, does not expect any difficulties in meeting the electricity demand in Port Hedland over the next five years. The Murdock Drive sub-station in South Hedland is running with considerable spare capacity and can accommodate further development in South Hedland.

Gas

The Environmental Report for the proposed Boodarie Strategic Industrial Estate indicates the PEPL pipeline is unlikely to have any significant excess capacity to support major industrial users due to commitments for the PEPL Power Station and the HBI Project. Therefore it is anticipated any future major gas users are likely to require a new pipeline from Dampier which would be constructed in the existing 600m PEPL corridor. There is no reticulated gas supply in Port Hedland and provision of this infrastructure would only be investigated if there was a technology developed which permits airconditioning units to be powered by natural gas.

Water

Water from the De Grey and Yule wellfields is pumped to bulk storage tanks in South Hedland between North Circular Road and the Great Northern Highway. Water is then transferred into other bulk storages in Port Hedland and Finucane Island. Elevated tanks in Port and South Hedland provide pressure for their respective areas. These towers are refilled by pumping from bulk storage facilities. The capacity and elevation of existing facilities is as follows:

STORAGE	CAPACITY (m3)	Top Water Level (m AHD)
South Hedland (ground tanks)	2 x 25,000 9,000	14.5
South Hedland (elevated tank)	2,250	46.2
Port Hedland (ground tanks)	3 x 9,000	9.9
Port Hedland (elevated tank)	800	50
Finucane Island (ground tank)	2,500	12.4

Table 10 - Capacity and Elevation of Water Tanks

Wastewater

Most of the Port Hedland townsite is serviced by deep sewerage, with the exception of the older areas of Port Hedland west of the water tower. These areas are to be sewered as part of the Water Corporation's Infill Sewerage Program which commenced in 1997/98. South Hedland is entirely sewered.

Wastewater Treatment Plants (WTP) are located in Port Hedland, South Hedland, the airport and Wedgefield. Treated effluent from the Port and South Hedland WTPs is used for watering parks and ovals and provides an effective effluent-disposal strategy and reduces demand for scheme water. Demand for treated effluent may increase if BHP takes up its scheme water allocation from the Port Hedland Water Supply Scheme for the HBI Project and dust suppression at Nelson Point.

Port Hedland Wastewater Scheme

The Water Corporation has prepared long-term planning for the coastal Port Hedland Wastewater Scheme, which includes capacity for development proposals in Pretty Pool and the infill sewerage program for the western half of the town.

The Port Hedland WTP has a nominal capacity of 7,000 EP (equivalent persons) and is currently operating at 40 per cent capacity. The location of the plant is somewhat of a constraint to future

urban development in the Spinifex Hill area, with about 150 homes already in the nominal 500m buffer area. The linear nature of Port Hedland restricts opportunities to relocate the facility in the immediate vicinity without encroaching on existing or proposed development.

The nominal buffer area of 500m can be reduced considerably, if alternative treatment technologies are used. However, it should be noted that these technologies are very costly, and any change in this regard will be developer driven. The location and elevation of the plant on the Pretty Pool tidal flats makes it susceptible to flooding in the event of storm surge.

South Hedland Wastewater Scheme

South Hedland is serviced by the South Hedland Wastewater Scheme, which comprises 11 existing sewer catchments and pump stations and a wastewater treatment plant approximately two km west of the town. Planning indicates four additional sewer catchment areas are required to service undeveloped land in East Koombana with two additional catchments likely for the balance of the town centre.

The current WTP consists of four primary and four secondary treatment ponds with an estimated capacity of 2800m^3/day (estimated 12,000 EP). The plant was operating at 90 per cent in June 1996 during the construction phase of the HBI Project. Additional capacity in the short term is likely to be through the installation of a temporary aeration unit. Treatment facilities are adequate to meet anticipated demand well into the future but options for long-term effluent disposal from the South Hedland plant are under consideration.

A number of operational issues have resulted in the South Hedland Re-use Scheme operating at less than optimum in recent times. The scheme was developed in 1980 as a joint-use system by the Town for recreation ground irrigation and school oval watering. The quality of the effluent has generated odour impacts from time to time, mainly from algae growth in the treatment lagoons plus long detention times of treated effluent in the storage and reticulation system. The Water Corporation is investigating ways to reduce the algae content of the treated wastewater from the sewerage pond systems.

Wedgefield

A limited tertiary treatment facility is operated by the Town of Port Hedland to service several lots in Schilliman Street, Wedgefield, including the P&O Catering Single Persons' Quarters (SPQs). The facility has recently been upgraded to handle effluent from additional SPQs being located in the immediate area. However, the scheme is neither designed for, nor has the capacity to support "wet" industry that requires wastewater facilities.

Airport Precinct

Dixon's Caravan Park and the Walkabout Hotel, opposite the airport, operate private treatment lagoons in the immediate vicinity. If development is to increase in this area, either through tourism development or light industrial uses to the north, some consideration will be required as to the upgrading of the existing facilities or the installation of a new facility. Consideration will also have to be given for the provision of a buffer zone.

Landfill

A landfill site is currently located to the east of South Hedland, approximately 1,500m from the nearest residential area. The Town of Port Hedland estimates that the current site will be adequate for the next 10-15 years, at which time additional land will be required. Council has commenced negotiations with DOLA to secure additional land to the north of the site.

Road Network

The North West Coastal Highway to the south and the Great Northern Highway to the north and south is Port Hedland's major road transport link to the rest of the State. Other important road links in the townsite include Wilson Street, which links Port to South Hedland, and Wallwork and Hamilton Roads which link the highways to South Hedland.

As outlined previously, the cadastre and vesting of land in the area bound by the Great Northern Highway, Hamilton, Wallwork and North Circular Roads requires review as the original road planning made provision for a substantial interchange which may no longer be relevant.

Main Roads Western Australia completed a road safety audit for the Port Hedland Road and part of the Great Northern Highway in 1996. The study made a number of recommendations in terms of signage, street lighting and traffic treatments. The main recommendations related to the Cargill Salt entrance to the Port Hedland Road and as a result of the audit, negotiations between MRWA and Cargill Salt have determined a suitable access route for the triple road trains entering and departing the Cargill Salt lease area. An access road has been constructed under the Redbank Bridge by Cargill Salt, and MRWA has constructed another lane adjacent to the existing overtaking lane.

In addition to the road safety audit, MRWA has undertaken a draft roadscape strategy for the Great Northern Highway in Port Hedland. The report identifies and makes recommendations for potential roadscape enhancements of the verges, major intersections, and roadside facilities associated with the Great Northern Highway approaches and entry into Port Hedland. Options for implementation include MRWA's Regional Operational Plan or a Townscape Enhancement Plan. MRWA's Regional Operational Plan is considered the preferred option, as it is an existing program.

5.3.7 Opportunities and Constraints

A number of opportunities and constraints that require consideration in the preparation of the Structure Plan have been identified:

Opportunities

- Port Hedland's lifestyle and community spirit.
- Extensive tidal/sand flats in Pretty Pool provide scope for major new coastal residential development subject to Environmental Impact Assessment. This may greatly assist the viability of coastal commercial activity. This is demonstrated by current proposals for the area, although there is the potential for development costs to be very high.
- Use of Pretty Pool as a major recreation/tourist node.
- Extensive land on airport periphery for a variety of uses; including SPQ and tourist accommodation, light industry and Council depots.
- Use of the Spoilbank as a major recreation/tourist node, although not for permanent structures.
- Nature-based and cultural tourism enterprises such as Aboriginal culture and heritage tours, turtle watching, diving and fishing.
- Townscape improvements in the Port Hedland town centre, including coastal development - Sealanes car park as a community park, and foreshore areas for commercial development such as restaurants, shops and other tourist attractions.
- Industrial tourism.

Constraints

- Tidal storm surge and associated inundation.
- Flooding from cyclonic rainfall run-off.
- Retention and incorporation of buffers for major industrial activity (in keeping with *State Industrial Buffer Policy*) and associated transport linkages to minimise compromising these activities that form the basis of much of Hedland's economic activity.
- Extensive network of infrastructure active, i.e. railways and roads, static, i.e. pipes and transmission systems.
- Current road network in the Wedgefield/South Hedland area.
- Existing Port Hedland Wastewater Treatment Plant.
- Old tip site at 4 Mile Creek.
- Limited development potential in Port Hedland.
- Noise and dust from industry and development sites.
- Extensive tidal flats which provide ideal breeding grounds for mosquitos.

5.4 Structure Plan

5.4.1 Proposed Land Uses

The proposed Structure Plan is shown on Map 12 and the various land uses are discussed below:

Residential

Major residential growth areas are indicated at Pretty Pool, Koombana and the long-term southerly extension of South Hedland.

The dwelling capacity of the Port Hedland locality may increase as a result of the Water Corporation's Infill Sewerage Program in the area between the port and the Council offices. This may allow re-subdivision and infill development, with a potential to double housing density. Some older housing stock may be completely redeveloped. Spinifex Hill and Cooke Point are virtually fully developed with the major growth for the coastal area coming from Pretty Pool.

Lot yield for vacant residential land in existing South Hedland neighbourhoods and Koombana is based on nine dwellings/ha whereas for the long-term South Hedland extension, a yield of eight dwellings/ha has been used to allow for public use sites such as schools and drainage works which are all established in the existing areas. A higher density of 12 lots/ha has been applied to the 30ha residential node on the western end of the South Hedland town centre.

Table 11 shows an indicative housing and nominal population capacity of the proposed residential areas based on an occupancy rate of three persons per dwelling.

Rural Residential

Potential and existing Rural Residential areas are shown at Turner River, Redbank and the South Hedland Rural Estate. The Turner River has limited scope for expansion due to the absence of a reticulated water supply.

The Redbank area has limited scope for development and the area at 12 Mile is the existing DOLA subdivision. This area would be more viable if it had a reticulated water supply and has considerable scope for expansion to the east.

Additional areas have been shown for potential Rural Residential development at the South Hedland Rural Estate, which likely to meet anticipated demand for this type of development for the foreseeable future. Due to the poor quality and quantity of water available in and around Port and South Hedland, there is limited potential to develop Special Rural and Rural land in the area, particularly as private wells are unlikely to be suitable for irrigation. Any estates of this sort would generally require connection to scheme water supply, which is likely to preclude water-intensive land uses such as horticulture.

Commercial/Town Centre

Town centre uses are shown for expansion mainly in South Hedland, with limited development likely in Port Hedland. The South Hedland town centre is nominally 80ha. Approximately 30ha has been allocated to a Residential/Mixed Use zone. It is important that land uses in the Mixed Use area do not conflict with residential areas and they should be limited to office/cottage industry uses. Most commercial land needs can be met with the expansion of the South Hedland town centre.

Residential Precinct	Existing Dwelling Stock	Potential and Undeveloped Area(ha)	Est. Total Dwelling Capacity	Estimated Nominal Population
Port Hedland	400		800	2,400
Spinifex Hill/Cooke Pt	800		900	2,700
Pretty Pool	100	90	1,000	3,000
South Hedland Town Centre Extension		30	350	1,000
South Hedland Neighbourhoods	2,000	80	2,700	8,000
Koombana	800	190	2,500	7,500
South Hedland extension		850	6,800	20,000
TOTAL	4,100	1,240	15,050	44,600

Source: Department for Planning and Infrastructure, 1998

Table 11 - Population Capacity of New Residential Areas

Additional land for mixed business activities such as carpet, hardware and furniture salesrooms is shown in Anderson Street, Port Hedland, as an extension of existing service commercial space. The areas shown are close to existing town centres and capable of providing adequate exposure and street frontage.

Parks and Recreation

It is anticipated that existing parks and recreation facilities will be adequate to service the Port Hedland area in the short to medium term. The regional sporting facility in South Hedland and the PCYC are to be upgraded under the South Hedland Enhancement Scheme, to improve access and the range of services and facilities offered.

Further development of Koombana and the area to the south will create additional land for parks and recreation through public open space contributions as part of the detailed planning and development process for the area.

Area Requiring Further Assessment

An area to the north (180ha) of North Circular Road has been identified as subject to further assessment. This land has been reserved for a variety of purposes, including a regional hospital, road reserves and infrastructure purposes, but is now somewhat of a “no man's land”. It appears to be surplus to existing and future needs and could be used for civic, cultural or recreational purposes although the eastern area may provide opportunities for further subdivision as larger lot rural residential uses for equestrian purposes. Development of the land must occur in the context of a detailed land use plan.

Industry

An extension of Wedgefield could provide an additional 100ha of industrial land, however most of the possible extension are is subject to inundation and is unlikely to be developed. The Town of Port Hedland is undertaking an Industrial Land Strategy, which will identify new areas for industrial development. There is additional capacity within airport land to accommodate a variety of land uses, including depots, uses associated with the airport and short term SPQ accommodation. The location of the airport is such that air traffic does not pass over the town.

An area for industry to service the proposed Boodarie Strategic Industrial Estate has been reserved to the east of Boodarie and south-west of Wedgefield. It is likely that this area will be developed on an as-needed basis, depending on the industries that locate in the proposed Boodarie Estate. This area could accommodate industrial land uses not compatible with Wedgefield, depending on the outcome of the Town of Port Hedland’s Industrial Land Strategy.

Land for strategic industry is shown in the proposed Boodarie Strategic Industrial Estate. It is anticipated that this site will be able to accommodate large industrial developments such as downstream processing and mineral resources.

Infrastructure Corridors

A number of strategic infrastructure corridors appear on the Structure Plan. These include existing rail and road corridors plus those identified in the environmental report for the proposed Boodarie Strategic Industrial Estate.

The plan provides for duplication of the 80m Newman and 60m Goldsworthy rail reserves to the south and west of the rail interchange. Recent zoning and development proposals have restricted duplicating the Newman line adjacent to Cargill Salt unless land is acquired from Cargill's lease. It is considered highly unlikely an additional line will be required to the northern side of the harbour given the extent of BHP’s lease. The corridors defined in the proposed Boodarie Strategic Industrial Estate are nominally 150m wide.

It should also be noted that the road network and reserves act as infrastructure corridors, not only for the passage of vehicles, but for the location of public utilities.

Aquaculture

Existing aquaculture leases are shown in the plan. No provision has been made for additional sites due to a lack of baseline information on site suitability or demand for sites. Suitable sites may be determined in the Pilbara-wide aquaculture-mariculture study to be co-ordinated by the PDC.

Tourism

The Structure Plan has identified main areas for tourism/recreation development at Cemetery Beach and the Wedge Street foreshore. The location of the sites allows for a coastal focus with potential for commercial development such as restaurants and nature-based activities such as a mangrove walk, turtle watching and marine-based recreation. The Wedge Street foreshore area also provides an ideal vantage point for watching the stream of shipping traffic entering and departing the port of Port Hedland.

There is also potential in the Port Hedland area for industrial tourism to take advantage of the major industry operations and for Aboriginal tourism which highlights the rich culture and heritage values of the area.

Transport

Airport

The Port Hedland International Airport has the capacity to accommodate aircraft up to 737s and has sufficient space to upgrade its capacity, should the need arise. The path taken by aircraft does not affect residential areas and the airport is well placed to meet future air transport needs. There may be a need to develop noise and height restrictions from the airport in light of development proposals for land surrounding the airport and for possible strategic industry sites in the proposed Boodarie Strategic Industrial Estate.

Road Network

A ring road is shown around the South Hedland townsite, branching off from Hamilton Road. This road is designed to accommodate future growth to the south of South Hedland and to alleviate vehicular pressure on roads in the town centre. The road also forms the levee for flood protection from South Creek.

The Structure Plan includes a new eastern link road from South Hedland to the Great Northern Highway. The project has been included in the *Roads 2020 Regional Road Development Strategy* as project PIL 21. The road provides an alternative access to and from South Hedland which includes improving accessibility to the recreation area east of the airport.

A road linking the Great Northern Highway at Wedgefield to the Great Northern Highway east of the airport is shown on the Structure Plan. This would assist in rationalising the road network and would also provide greater access to the southern side of the airport, as it is intended that this area be developed for a variety of commercial uses. The road could also serve as a bypass and remove heavy vehicles from the local road network. However, this is not necessarily desirable from the town's point of view, as a bypass road may have a negative impact on tourism and short-stay accommodation. Construction of the bypass road would also affect the location of the truck stop opposite the cemetery, which currently serves as a parking and rest area for road trains and other heavy vehicles. Construction of a bypass road may not be necessary for a number of years, but it is important to keep it as an option and ensure that the land is not compromised with ad hoc development.

Grade separation between the Great Northern Highway and the Goldsworthy rail corridor should be a longer-term priority to remove delays associated with rail operations that are expected to increase over time. Grade separation is not identified in Roads 2020 but should be a consideration in future reviews.

Infrastructure

Water Supply

Indications are that no additional major infrastructure will be required to support further development in the Port Hedland area.

Sewerage

Expansion of wastewater treatment in the coastal Port Hedland area is expected to be minor. Continued and expanded re-use of treated effluent will provide an effective disposal strategy.

The current South Hedland Wastewater Treatment Plant site of 19ha has limited scope for any significant increase in the current lagoon treatment technology. Advice from the Water Corporation suggests alternative disposal technologies will be introduced to handle the long-term development of South Hedland. This should also improve the quality of the treated effluent for re-use. Long-term

effluent disposal is the critical issue. No allocation for land has been made for additional effluent evaporation ponds in this Study as it is assumed the re-use will be maximised as part of the greening program.

Power

A sub-station may be required in the Pretty Pool area where more than 1,000 new lots are proposed, so land and appropriate buffer zones should be allocated in that area.

Education

An additional high school will be required in the South Hedland extension area along with at least five or six additional primary schools. This includes at least one additional school in the Koombana area in the short term.

5.4.2 Structure Plan Implementation

Outline Development Plans (ODPs) are an essential part of implementing the Structure Plan and should be prepared for all areas marked for future residential use. While adopting the broad principles of the Structure Plan, ODPs take it to a further level of detail, outlining the road network, public open space, primary schools, neighbourhood shopping centres, public purpose sites and other major sites of interest.

The preparation of ODPs for the sites identified in the Structure Plan is generally the responsibility of developers and landowners and may include the Town of Port Hedland. However, the Department for Planning and Infrastructure is prepared to offer assistance and guidance.

The area covered by the Structure Plan can be divided into a number of neighbourhood precincts. ODPs should be prepared in the Pretty Pool and Koombana areas as a matter of priority, then other major residential areas as the need arises.


LA AMELITA

6.0 Implementation

6.1 Implementation

The Port Hedland Area Planning Study is endorsed by the Western Australian Planning Commission. This level of endorsement guides local strategic and statutory planning and relies significantly on the provisions and zoning plans of the town's town planning scheme, and is seen as the most appropriate implementation mechanism for this study.

6.2 Levels of Implementation and Co-ordination

The majority of the implementation of the Study will be effected through the Town of Port Hedland's Town Planning Scheme.

At the end of each section a number of recommendations are included for implementation. The principal agencies involved in the recommendations are listed, with the lead agency or agencies indicated in bold lettering.

A regional co-ordinating committee for the Pilbara is proposed to provide effective coordination, prioritisation and implementation of recommendations. This committee would also be involved with the implementation of the *Pilbara Land Use Strategy and the Karratha Area Development Strategy*.

Implementation of specific recommendations will be the responsibility of agencies identified and subject to the guidance of the Regional Co-ordinating Committee.

6.3 Other State and Local Government Initiatives

A number of State Government agencies have specific roles for planning, development and management. This Study recognises the range of programs and reflects the many reports and initiatives by the various government agencies.

Many of the recommendations and implementation mechanisms rely on the involvement of the Town of Port Hedland in co-ordinating further localised planning and decisions about land use proposals.

6.4 Associated and Ongoing Studies

Planning issues continually require planning responses and this Study is part of an interactive process.

The Study has identified the issues and the type and direction of assessment needed. Other agencies and the Town of Port Hedland, in developing their own planning, strategies and programs, will need to have regard to the Port Hedland Area Planning Study. The following ongoing studies have particular relevance to the outcome of this Study:

- Environmental study of Port Hedland and Port Expansion Options and Boodarie Strategic Industrial Estate Service Corridor Options for the Port Hedland Port Authority and the Department of Resources Development
- *Guidance Statement for Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline*
- The North-West Shelf Marine Environmental Management study
- DEP Air Quality Management Plans for Strategic Industrial Estates
- Town Planning Scheme No. 5 for the Town of Port Hedland

6.5 Private Enterprise and Private Involvement

In many aspects there is potential for more innovative approaches to involving private enterprise in implementing the Study. The commercial aspirations, if focused on the economic benefits of long-term development, can be beneficial to the Port Hedland area. These may include concentrating of particular developments, such as:

- mining resource development;
- downstream processing;
- urban expansion and associated development;
- tourism and recreation node development;

- marine-based recreation and nature-based tourism;
- aquaculture development; and
- infrastructure provision.

6.6 Monitoring and Review

The dynamic nature of planning and development in the Port Hedland area requires that the Study is monitored and reviewed. The information gaps and further research needs identified throughout the report must be pursued, and the associated and ongoing studies identified should be incorporated in the Study where appropriate.

It is recommended that the Study be reviewed every five years to coincide with the Town of Port Hedland's next town planning scheme review.

Recommendations

- Establish a locally based Regional Co-ordinating Committee, as outlined in the *Pilbara Land Use Strategy*, to progress implementation of the Port Hedland Area Planning Study. (**WAPC/DPI**)
- Prioritise recommendations for implementation. (**Regional Co-ordinating Committee**)
- Integrate into the Study the relevant outcomes and recommendations of associated and ongoing studies as they are finalised. (**DPI**)
- Review the Study every five years. (**DPI**)

Appendix A

References and Studies Undertaken for the Port Hedland Area

Note: Titles shown in italic are published documents

Study/Project	Author	Date
• *A Background Paper for a State Heavy Industry Policy*	Dover Consultants, for Department of Resources Development	1995
• *A Nature Based Tourism Strategy (Draft)*	Western Australian Tourism Commission and Department of Conservation and Land Management	1995
• A Representative Marine Reserve System for Western Australia (The Wilson Report)	Marine Parks and Reserves Working Group	1994
• *A Science and Technology Policy for Western Australia*	WA Government	1997
• A Strategy Report for the Co-ordination of the Pilbara Tourism Industry	Tourism Co-ordinates, for Pilbara Development Commission	1995
• Accommodation Study of the Pilbara Region	Pilbara Development Commission	1994
• An Assessment of the Need for Secure Landfill Facilities in the Pilbara	Department of Environmental Protection (Rust PPK P/L, consultants)	1996
• *Australia's Oceans - New Horizons Oceans Policy Consultation Paper*	Commonwealth of Australia	1997
• BHP DRI Project - Accommodation Study	Naralup Associates	1995
• BHP Storm Surge Study	Bureau of Meteorology - Special Services Branch	1995
• Boodarie Resource Processing Estate Drainage and Flood Management Study	Jim Davies and Associates, for Department of Resources Development and LandCorp	1995
• *Boodarie Resource Processing Estate, Port Hedland, Bulletin 784*	Environmental Protection Authority	1997
• Conservation Through Reserves Committee Report to EPA	Conservation Through Reserves Committee	1974
• *Directory of Important Wetlands in Australia (Third Edition)*	Australian Nature Conservation Authority	2001
• Greater Port Hedland Storm Surge Study	Global Environmental Modelling Services (GEMS); for the Town of Port Hedland, Ministry for Planning and Department of Resources Development.	2000
• *Guidance Statement for Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline*	Environmental Protection Agency	2001
• Identifying Opportunities for Increasing Tourism in the Pilbara	Market Equity, for the Pilbara Development Commission	1995

Study/Project	Author	Date
• *New Horizons in Marine Management*	(WA Government)	1994
• Ngarda Ngarli Yandu (South Hedland) ATSIC Region - Housing and Infrastructure Data	Aboriginal Affairs Department	1995
• Pilbara/Gascoyne Islands Ecotourism Management Strategy	Tourism Co-ordinates, for the Pilbara Development Commission	1995
• *Pilbara 21*	State Government initiative	1992
• *Pilbara Economic Development Strategy*	Pilbara Development Commission and Department of Commerce and Trade	1996
• *Pilbara Economic Perspective*	Pilbara Development Commission	1996
• *Pilbara Land Use Strategy*	Pilbara Development Commission	1997
• *Pilbara Region Water Resources Review and Development Plan*	Water and Rivers Commission	1996
• *Pilbara Regional Profile*	Pilbara Development Commission	1995
• *Pilbara Regional Transport Strategy*	Department of Transport	1997
• Port Hedland and South Hedland Recreation Needs Study	Landvision and Shirley Barnes and Associates, for the South Hedland Enhancement Scheme	1996
• *Port Hedland Coastal Plan (Draft - for Public Comment)*	Department of Planning and Urban Development	1992
• *Port Hedland Land Development Program*	Ministry for Planning	1996 & 1997
• *Port Hedland Land Use Survey*	Ministry for Planning	1997
• *Port Hedland Port Authority - Port Strategy*	Port Hedland Port Authority	1995
• Port Hedland Road - Road Safety Audit	Main Roads Western Australia	1996
• Port Hedland Town Planning Scoping Papers Scheme Review	Landvision, for the Town of Port Hedland	1996
• *Port Hedland Townscape Study*	Department of Planning and Urban Development	1991
• Port Hedland Water Source Strategy	Water Corporation	1996
• Report of the Chief Executive Working Party on Essential Services to Aboriginal Communities	WA Government	1995

Study/Project	Author	Date
• *Roads 2020 Regional Road Development Strategy*	Main Roads Western Australia	1997
• South Hedland Options and Opportunities Study Planning	Landvision, for the South Hedland Enhancement Scheme	1996
• South Hedland Town Centre Development Plan	Feilman Planning Consultants, for the Town of Port Hedland	1996
• *State Industrial Buffer Policy*	Western Australian Planning Commission	1997
• *State Planning Strategy*	Western Australian Planning Commission	1997
• The Potential for Horticultural Development in the Pilbara, Western Australia	Don McGee, for the Pilbara Development Commission	1993
• *The Role of Ports in Western Australia*	WA Government	1995
• *The Way Ahead - Maritime Transport Directions for Western Australia*	Department of Transport	1995
• *Town of Port Hedland - A Social Profile*	Hedland College Social Research Centre	1996
• Transmission Development Plans 1996-2001	Western Power Corporation	1996
• *Upgrade of Dust Management at Finucane Is. and Nelson Point, Port Hedland*	Environmental Protection Authority Bulletin 831	1996
• When ERPs Aren't Enough - A Discussion of Issues Associated with Service Population Estimation	Australian Bureau of Statistics Demography Working Paper 96/4	1996

Appendix B

People and Organisations Consulted in the Preparation of the PHAPS and People and Organisations Who Made Submissions on the PHAPS

Organisation	Person(s) Consulted
Agriculture Western Australia	Wayne Fletcher
Department of CALM	Peter Kendrick, Alan Shields, Fran Stanley
Western Power Corporation	Roger Petit
Department of Environmental Protection	Steve Vellacott, Ray Macini, Ken Rayner, Peter Hoar, Bridgid Todd
Department of Resources Development	Ian Briggs, Chris Smith
Port Hedland Port Authority	Ian Baird, Graeme Gardner, Ian Hutton
Port Hedland Chamber of Commerce and Industry	Perry Heynan, Margaret Hayter, Dominic Pulumbo, Peter Dunning
Fisheries Western Australia	Laurie Edwards, Ken O'Reilly
BHP Iron Ore	Derek Miller
Town of Port Hedland	Tony Ford, Chris Hurtsfield, Michelle McKenzie, Suzanne Brown, Azhar Awang
State Emergency Service	Denis Rayner
Landvision Planning Consultants	Cam Watts, Trevor Moran
Private Consultant	Gino Garbelini
Office of Energy	Richard Harris
Pilbara Tourism Association	David Kirkland

People and Organisations Who Made Submissions on the Port Hedland Area Planning Study

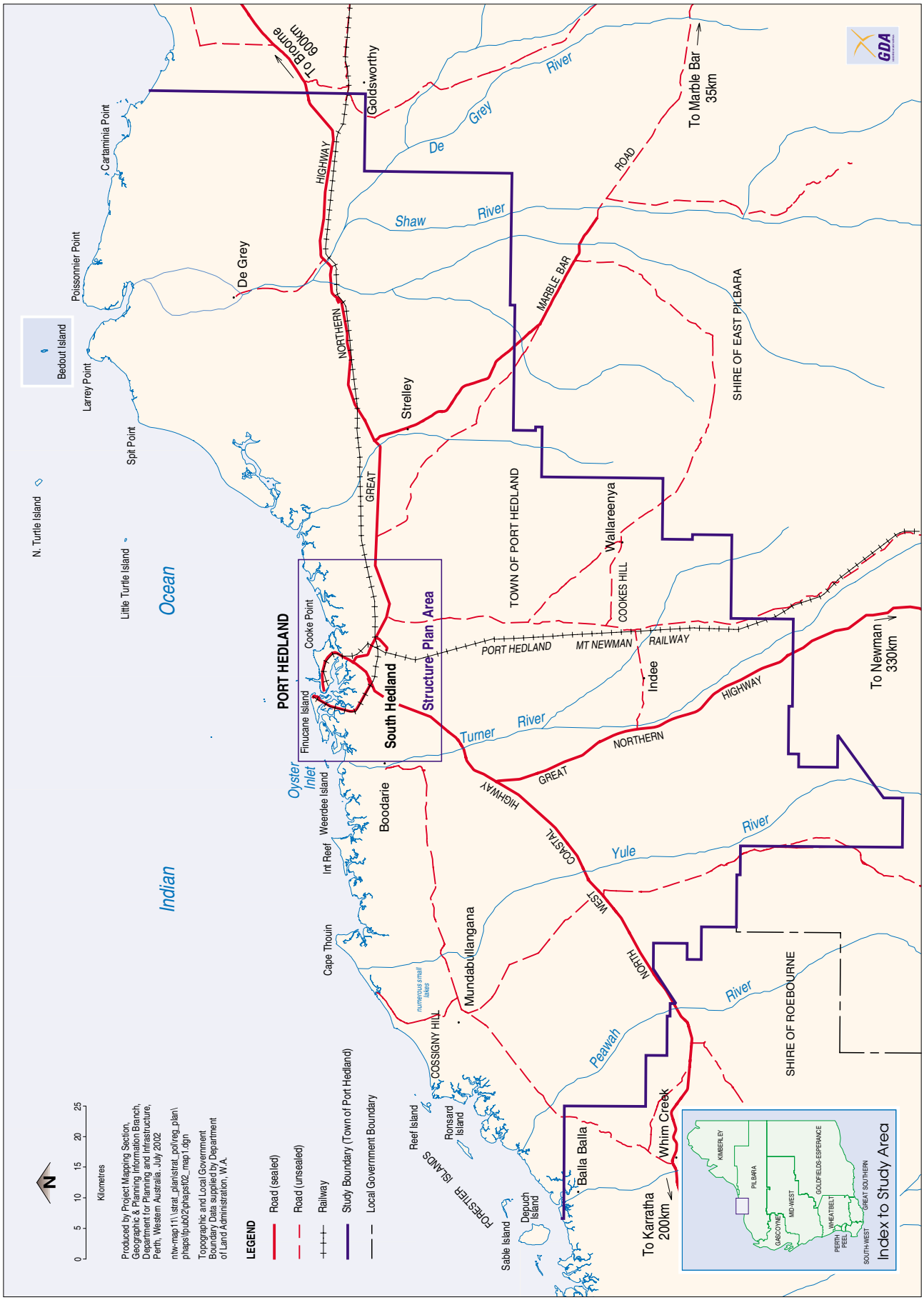
- Le Mer (Joe Rinkens)
- John Smart
- Veronica Park
- Judith Enright (LEAF)
- Local Environment Affinity Force
- Mr Bowen
- Sandra Battersby-Suggett
- Port Hedland Port Authority
- Department of Resources Development
- Homeswest
- Pilbara Development Commission
- Town of Port Hedland
- Water Corporation
- Water and Rivers Commission
- The Pastoralists and Graziers Assoc.
- WJ Wilson
- Warren Jacka

Appendix C

List of Abbreviations

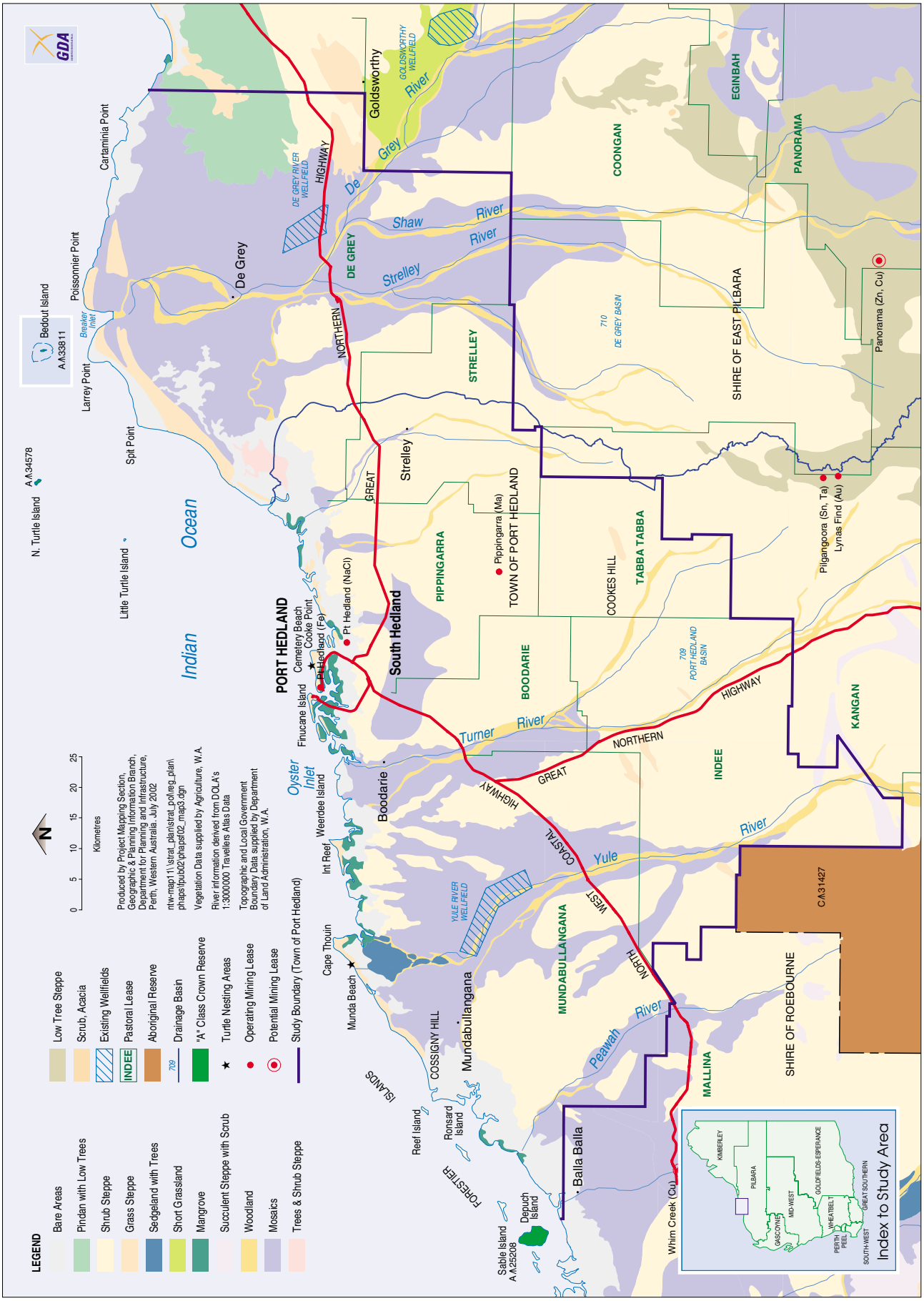
AAD	Aboriginal Affairs Department (now Department of Indigenous Affairs)
ABS	Australian Bureau of Statistics
AGWA	Agriculture Western Australia
AHD	Australian Height Datum
ATSIC	Aboriginal and Torres Strait Islander Commission
BHP	Broken Hill Proprietary
BOM	Bureau of Meteorology
BRM	Basic Raw Materials
CALM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
DIA	Department of Indigenous Affairs (formerly Aboriginal Affairs Deparment)
DIR	Department of Industry and Resources
DME	Department of Minerals and Energy (now Department of Mineral and Petroleum Resources)
DOCAT	Department of Commerce and Trade
DOLA	Department of Land Administration
DoF	Department of Fisheries (formerly Fisheries WA)
DOT	Department of Transport (now Department for Planning and Infrastructure)
DPI	Department for Planning and Infrastructure
DPUD	Department of Planning and Urban Development (now DPI)
DRD	Department of Resources Development (now Department of Industry and Resources)
DRI	Direct Reduced Iron
EPA	Environmental Protection Authority
ERP	estimated resident population
FESA	Fire and Emergency Services Authority
FWA	Fisheries Western Australia (now Department of Fisheries)
GEHA	Government Employees Housing Authority
HBI	Hot Briquetted Iron
LDP	Land Development Program
MfP	Ministry for Planning (now Department for Planning and Infrastructure)
MRWA	Main Roads Western Australia
Mt	million tonnes
ODP	Outline Development Plan
PDC	Pilbara Development Commission
PEPL	Pilbara Energy Pty Ltd
PH	Port Hedland
PHAPS	Port Hedland Area Planning Study
PHPA	Port Hedland Port Authority
PLUS	Pilbara Land Use Strategy
PTA	Pilbara Tourism Association
REIWA	Real Estate Institute of Western Australia
SHES	South Hedland Enhancement Scheme
SPQ	single persons' quarters
t	tonnes
tpa	tonnes per annum
TPH	Town of Port Hedland
UCL	Unallocated Crown Land
WAPC	Western Australian Planning Commission
WATC	Western Australian Tourism Commission
WC	Water Corporation
WPC	Western Power Corporation
WRC	Water and Rivers Commission
WTP	wastewater treatment plant

Map 1: Study Area

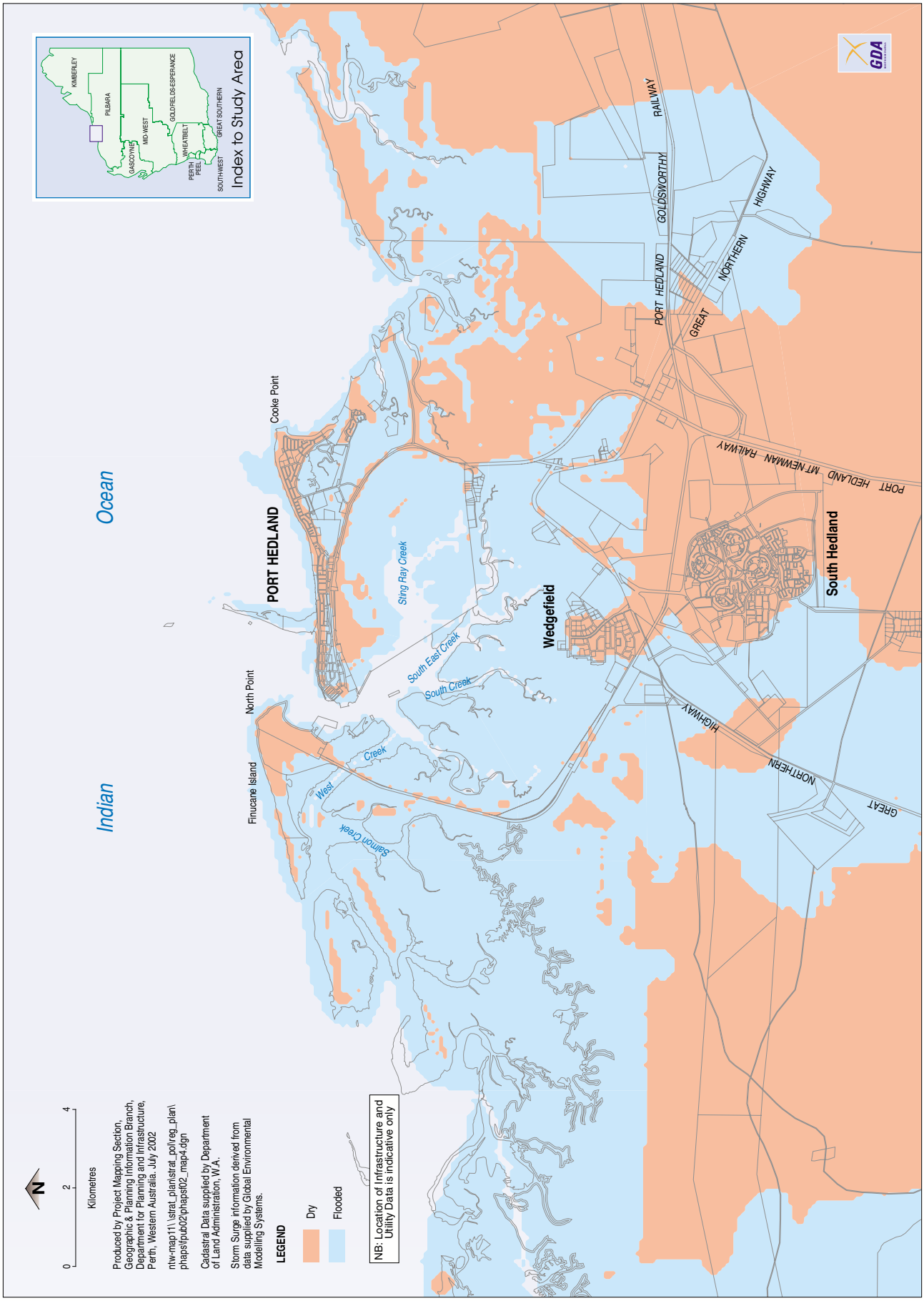


Map 2: State Planning Strategy Map

Map 3: Physical Characteristics, Natural Resources, Vegetation

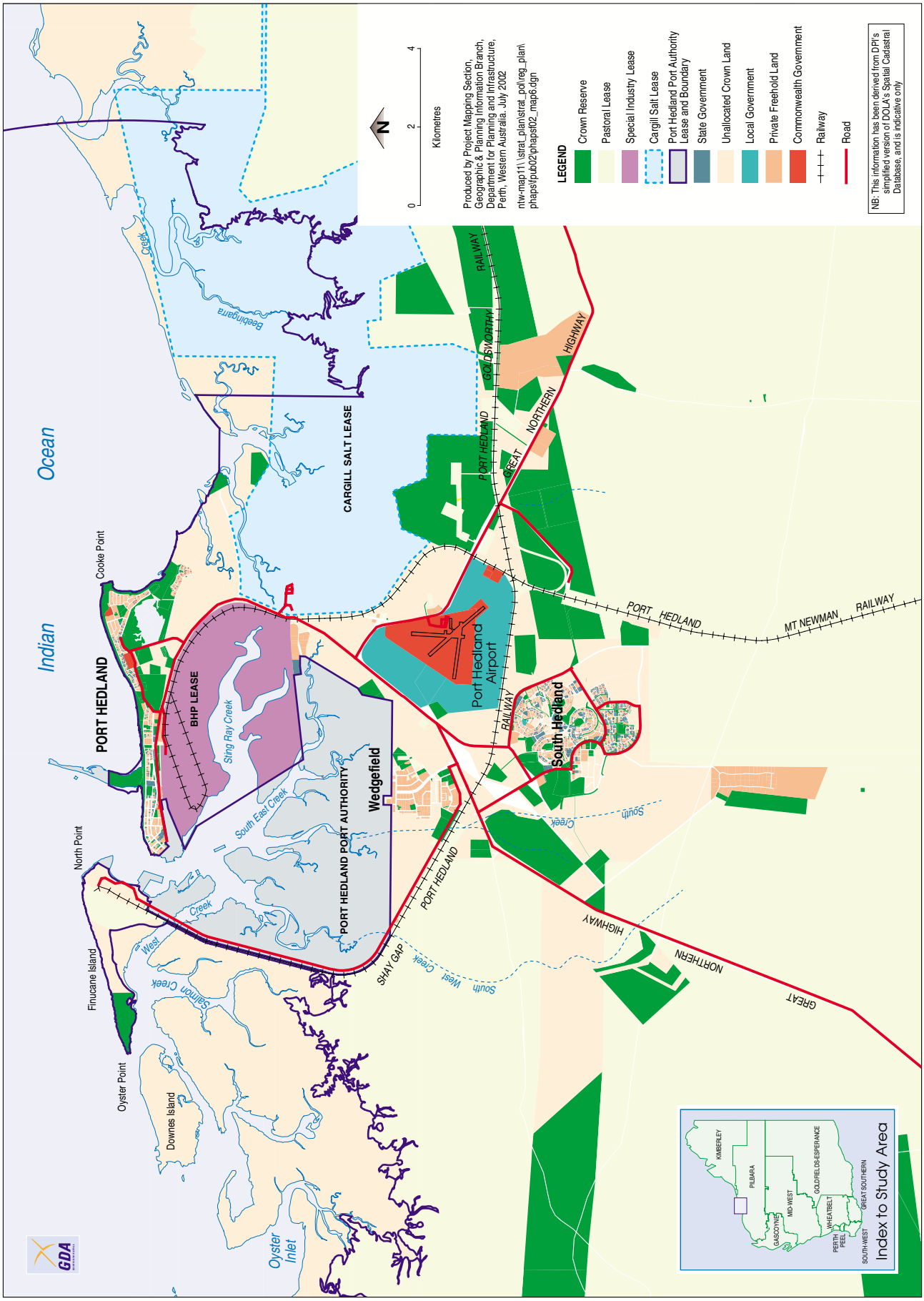


Map 4: Combined Storm Surge and Flood Map (1 in 100 year return period)

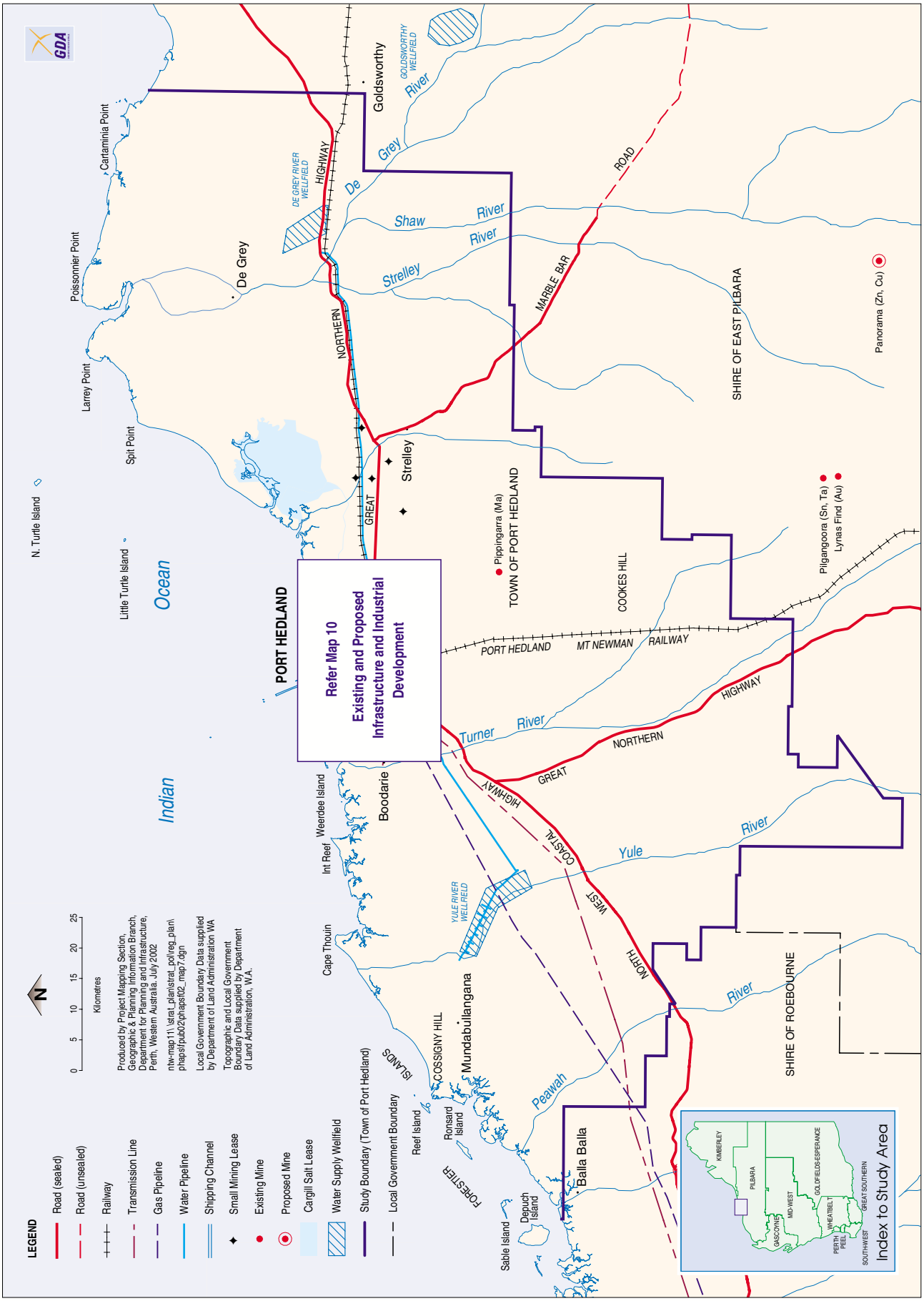


Map 5: Land Ownership (region)

Map 6: Land Ownership (structure plan area)



Map 7: Basic Raw Materials, Infrastructure and Industrial Development



Map 8: Sub-Regional Land Use

GDA

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0 5 10 15
Kilometres

Produced by Project Mapping Section, Geographic & Planning Information Branch, Department for Planning and Infrastructure, Perth, Western Australia. July 2002

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Cadastral Data supplied by Department of Land Administration, W.A.

Topographic and Local Government Boundary Data supplied by Department of Land Administration, W.A.

LEGEND

Crown Reserve
- Stock Route
- Recreation
- Public Utilities
- Mining and Quarrying
- Aboriginal Community
- Pastoral
- Unallocated Crown Land
- Private Freehold Land
- Subject to Inundation
- Groundwater Reserve

- Proposed Water Reserve
- Wellfield
- Wellfield Extension
- Existing Conservation
- Further Environmental Study Required
- Cargill Salt Lease
- Settlement
- Possible Dam Site
- Water Pipeline
- Transmission Line
- Main Road
- Roads to be Upgraded
- Railway
- Proposed Consolidated Infrastructure Corridor (including existing gas pipeline)
- INDEE Pastoral Lease
- Possible Conservation/ Tourist Node
- Small Mining Lease
- Horticulture
- Study Boundary (Town of Port Hedland)
- Local Government Boundary

Indian Ocean

N.Turtle Island
A/A34578
Bedout Island
A/A33811
Little Turtle Island
Larrey Point
Breaker Inlet
Poissonnier Point
Cartaminia Point
Spit Point

PORT HEDLAND

Refer Map 12

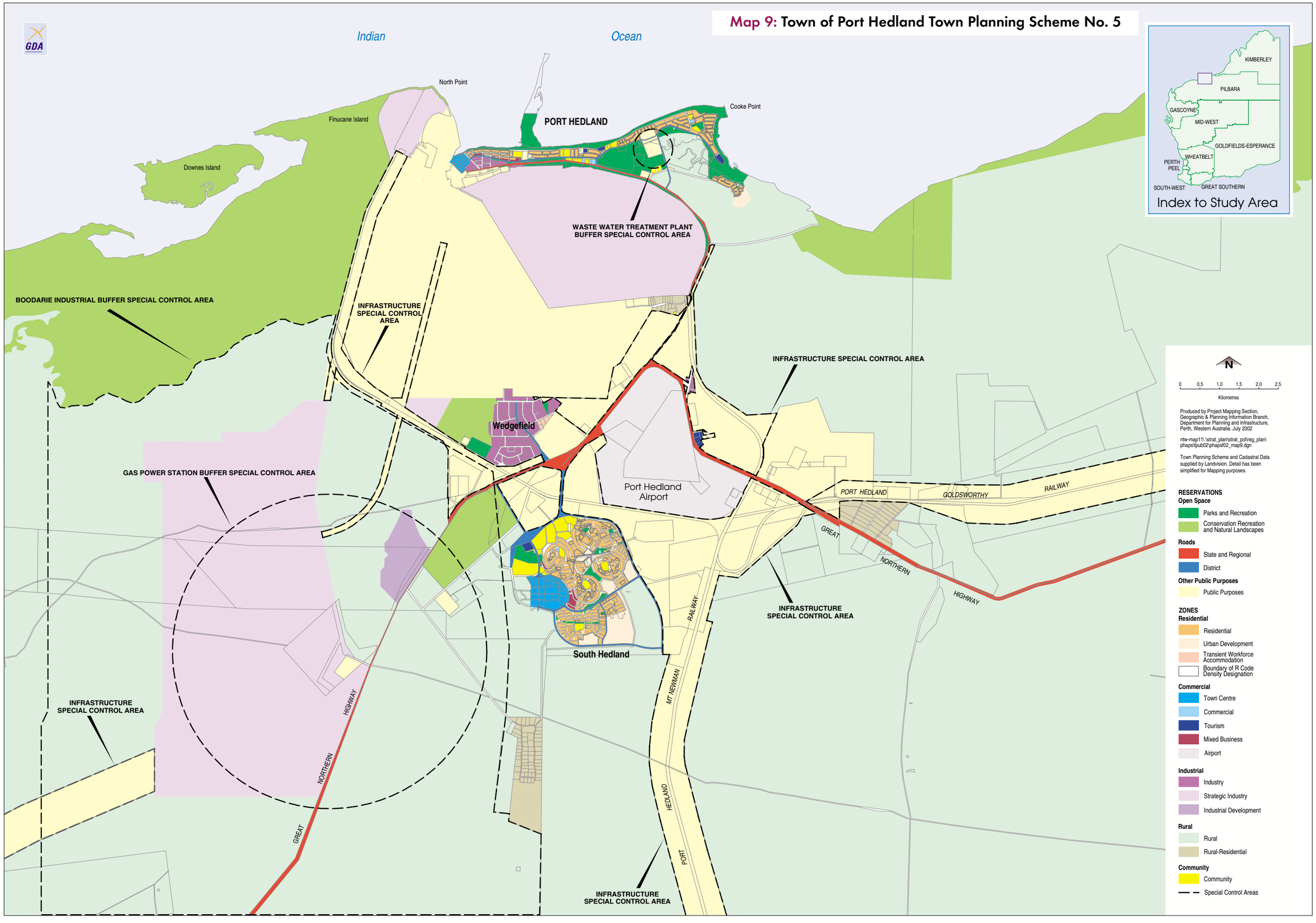
Structure Plan Study Area

Cape Thouin
Int Reef
Weerdee Island
Boodarie
ISLANDS
Reef Island
Cape Cossigny
COSSIGNY HILL
Mundabullangana
Forestier Bay
Ronsard Island
FORESTIER
East Island
Sable Island
Depuch Island Anchorage
Sandy Island
Balla Balla
Depuch Island
YULE RIVER WELLFIELD

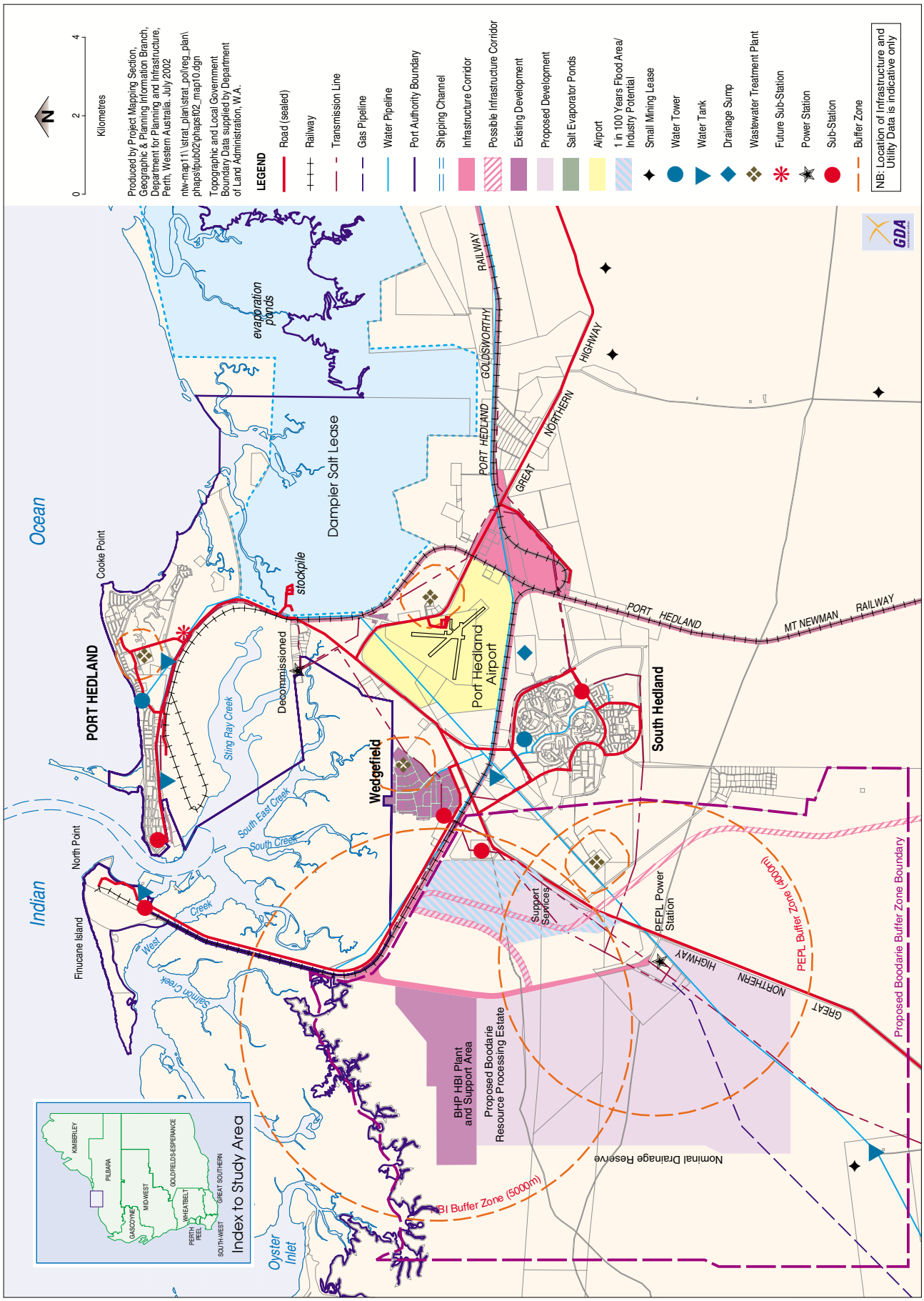
De Grey
DE GREY RIVER WELLFIELD
To Broome
GOLDSWORTHY RAILWAY
PORT HEDLAND
DE GREY
Goldsworthy
De Grey River
Strelley
STRELLEY
Strelley River
Shaw River
GOLDSWORTHY WELLFIELD
PIPPINGARRA
BOODARIE
Turner River
PORT HEDLAND HIGHWAY
GREAT NORTHERN HIGHWAY
TOWN OF PORT HEDLAND
MT NEWMAN RAILWAY
COOKES HILL
TABBA TABBA
MARBLE BAR ROAD
COONGAN
To Marble Bar
MUNDABULLANGANA
COASTAL HIGHWAY
WEST NORTH
Peawah River
Yule River
INDEE
SHIRE OF EAST PILBARA
EGINBAH
PANORAMA
To Karratha
MALLINA
SHIRE OF ROEBOURNE
KANGAN
To Newman (private)

Index to Study Area
KIMBERLEY
PILBARA
GASCOYNE
MID-WEST
GOLDFIELDS-ESPERANCE
WHEATBELT
PERTH
PEEL
SOUTH-WEST
GREAT SOUTHERN

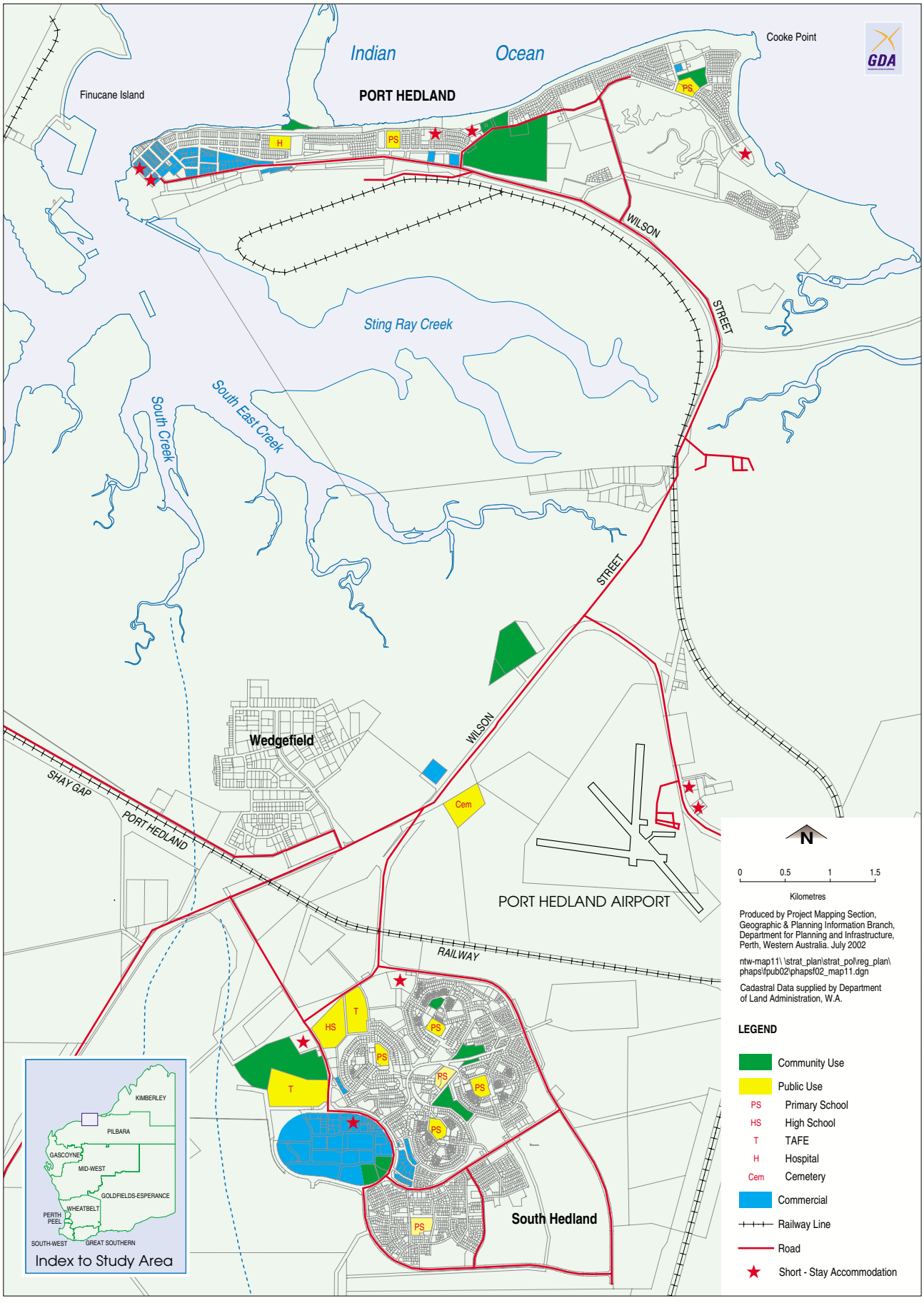
Map 9: Town of Port Hedland Town Planning Scheme No. 5



Map 10: Existing and Proposed Infrastructure and Industrial Development



Map 11: Commercial and Community Sites



Map 12: Port Hedland Structure Plan